Gestetner® RICOH® savin®

A156/A212...SERIES
SERVICE MANUAL

RICOH GROUP COMPANIES

PN: RCFM5535

Gestetner®

RICOH®

savin®

A156/A212...SERIES

SERVICE MANUAL

RICOH GROUP COMPANIES

Rev. 4/98

Gestetner® RICOH® SAVIN®

A156/A153
A160/A157
A162/A161

SERVICE TRAINING MANUAL

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Rev. 4/98

LEGEND

PRODUCT CODE	COMPANY		
	GESTETNER	RICOH	SAVIN
A156	2635TD	FT5535	9035DL
A153	2635	FT5035	9035
A160	2627TD	FT4527	9027DL
A157	2627	FT4027	9027
A162	2822TD	FT4522	9220DL
A161	2822	FT4022	9220
A207	CMR402	FT5840	9400D
A208	CMR321	FT5632	9032
A211	CMR322	FT5832	9032D
A206	CMR401A	FT5740	9400L
A204	CMR401	FT5640	9400
A210	CMR321A	FT5732	9032L
A212	—	FT4622	9122
A214	—	FT4822	9122DL

DOCUMENTATION HISTORY

REV. NO.	DATE	COMMENTS
1	**3/95**	Original printing
2	**7/95**	A162/A161 addition
3	**5/97**	A207/A208/A211 Addition
4	**12/97**	A212/A214 Addition

The A204 copier is based on the A153 copier.
The A206 copier is based on the A155 copier.
The A207 copier is based on the A156 copier.
The A208 copier is based on the A157 copier.
The A210 copier is based on the A159 copier.
The A211 copier is based on the A160 copier.
The A212 copier is based on the A161 copier.
The A214 copier is based on the A162 copier.

Only the differences from the base copiers are described in the following pages. Therefore, this documentation should be treated as an insert version of the base copier's service manual, although it has a separate binder. It should always be utilized together with the base copier's service manual.

WARNING

The Service Training Manual contains information regarding service techniques, procedures, processes and spare parts of office equipment distributed by Ricoh Corporation. Users of this manual should be either service trained or certified by successfully completing a Ricoh Technical Training Program.

Untrained and uncertified users utilizing information contained in this service manual to repair or modify Ricoh equipment risk personal injury, damage to property or loss of warranty protection.

Ricoh Corporation

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IMPORTANT SAFETY NOTICES

PREVENTION OF PHYSICAL INJURY

1. Before disassembling or assembling parts of the copier and peripherals, make sure that the copier power cord is unplugged.
2. The wall outlet should be near the copier and easily accessible.
3. Note that the drum heater and the optional anti-condensation heaters are supplied with electrical voltage even if the main switch is turned off.
4. If any adjustment or operation check has to be made with exterior covers off or open while the main switch is turned on, keep hands away from electrified or mechanically driven components.
5. The inside and the metal parts of the fusing unit become extremely hot while the copier is operating. Be careful to avoid touching those components with your bare hands.

HEALTH SAFETY CONDITIONS

1. Toner and developer are non-toxic, but if you get either of them in your eyes by accident, it may cause temporary eye discomfort. Try to remove with eye drops or flush with water as first aid. If unsuccessful, get medical attention.

OBSERVANCE OF ELECTRICAL SAFETY STANDARDS

1. The copier and its peripherals must be installed and maintained by a customer service representative who has completed the training course on those models.

⚠ CAUTION

2. The RAM board has a lithium battery which can explode if handled incorrectly. Replace only with the same type of RAM board. Do not recharge or burn this battery. Used RAM boards must be handled in accordance with local regulations.

SAFETY AND ECOLOGICAL NOTES FOR DISPOSAL

1. Do not incinerate toner cartridges or used toner. Toner dust may ignite suddenly when exposed to open flame.
2. Dispose of used toner, developer, and organic photoconductors in accordance with local regulations. (These are non-toxic supplies.)
3. Dispose of replaced parts in accordance with local regulations.
4. When keeping used lithium batteries (from the main control boards) in order to dispose of them later, do not store more than 100 batteries (from the main control boards) per sealed box. Storing larger numbers or not sealing them apart may lead to chemical reactions and heat build-up.

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OVERALL MACHINE INFORMATION

1. SPECIFICATIONS

Configuration: Desktop

Copy Process: Dry electrostatic transfer system

Originals: Sheet/Book

Original Size: Maximum A3/11" x 17"

Copy Paper Size:
Maximum
A3/11" x17" (Paper trays)
Minimum
A5/8 1/2" x 5 1/2" sideways (Paper trays)
A4/11" x 8 1/2" sideways (LCT)
A6/5 1/2" x 8 1/2" lengthwise (By-pass)

Duplex Copying:
Maximum
A3/11" x 17"
Minimum
A5/8 1/2" x 5 1/2" (sideways)

Copy Paper Weight:
Paper tray:
52 ~ 128 g/m^2, 14 ~34 lb
(A153, A155, and A156 copiers)
64 ~ 90 g/m^2, 17 ~ 24 lb
(A157, A159, and A160 copiers)
By-pass:
52 ~ 157 g/m^2, 14 ~42 lb
LCT:
52 ~ 128 g/m^2, 14 ~ 34 lb
Duplex copying:
64 ~ 105 g/m^2, 17 ~ 24 lb

Reproduction Ratios: 4 Enlargement and 6 Reduction

	A4/A3 Version	LT/DLT Version
Enlargement	200% 141% 122% 115%	200% 155% 129% 121%
Full size	100%	100%
Reduction	93% 82% 75% 71% 65% 50%	93% 85% 77% 74% 65% 50%

Power Source: 120V/60Hz:
More than 12 A (for North America)

Power Consumption:

		A153, and A156 copiers		A157, and A160 copiers	
		Copier Only	**Full System**	**Copier Only**	**Full System**
Maximum		1.45 KW	1.50 KW	1.45 KW	1.50 KW
Copying		1.00 KW	1.00 KW	0.80 KW	0.80 KW
Warm-up		0.90 KW	0.92 KW	0.90 KW	0.92 KW
Stand-by		0.16 KW	0.19 KW	0.15 KW	0.17 KW
Energy Saver	1	0.15 KW	0.17 KW	0.14 KW	0.16 KW
	2	0.13 KW	0.15 KW	0.12 KW	0.13 KW
	3	0.12 KW	0.14 KW	0.09 KW	0.10 KW
	4	0.11 KW	0.12 KW	0.07 KW	0.08 KW
	5	0.09 KW	0.11 KW	0.05 KW	0.06 KW
	6	0.07 KW	0.09 KW	–	–
Auto Off		0.02 KW	0.04 KW	0.02 KW	0.04 KW

NOTE: 1) Full System: Copier + ADF + Paper Tray Unit + 20 Bin S/S
2) Energy Saver: See SP1-105-002
3) Auto Off: See SP5-305

A161 and A162 Copiers			
		Copier Only	**Full System**
Maximum		1.45 KW	1.50 KW
Copying		0.64 KW	0.72 KW
Warm-up		0.95 KW	0.97 KW
Stand-by		0.15 KW	0.17 KW
Energy Saver	1	0.14 KW	0.16 KW
	2	0.12 KW	0.13 KW
	3	0.09 KW	0.10 KW
	4	0.07 KW	0.08 KW
	5	0.05 KW	0.06 KW
Auto Off		0.02 KW	0.04 KW

NOTE: 1) Full System: Copier + ADF + Paper Tray Unit + 10 Bin S/S
2) Energy Saver: See SP1-105-002
3) Auto Off: See SP5-305

Noise Emission:

	A153, and A156 copiers		A157, and A160 copiers	
	Copier Only	**Full System***	**Copier Only**	**Full System***
1. Sound Power Level				
Copying	66 dB(A)	68 dB(A)	61 dB(A)	67 dB(A) (L_{WA})
Warm-up	41 dB(A)	41 dB(A)	39 dB(A)	40 dB(A) (L_{WA})
Stand-by	41 dB(A)	41 dB(A)	39 dB(A)	40 dB(A) (L_{WA})
2. Sound Pressure Level at the operator position				
Copying	58 dB(A)	57 dB(A)	54 dB(A)	56 dB(A) (L_{PA})
Warm-up	33 dB(A)	27 dB(A)	32 dB(A)	27 dB(A) (L_{PA})
Stand-by	33 dB(A)	27 dB(A)	32 dB(A)	27 dB(A) (L_{PA})

NOTE: The above measurements are to be made according to ISO 7779.
* : Full System: Copier + ADF + Paper Tray Unit +10 Bin S/S.

Dimensions:

	Width	Depth	Height
A153 copier	1030 mm (40.6")	655 mm (25.8")	606 mm (23.9")
A157/A161 copier	900 mm (35.5")	655 mm (25.8")	606 mm (23.9")
A156 copiers	1258 mm (49.6")	655 mm (25.8")	606 mm (23.9")
A160/A162 copiers	1128 mm (44.5")	655 mm (25.8")	606 mm (23.9")

Measurement Conditions
1) With by-pass feed table closed
2) With platen cover and copy tray attached
3) With LCT cover closed

Weight:

	Weight
FT5035 A153 copier	About 70 kg (154.2 lb)
FT5535 A156 copier	About 82 kg (180.7 lb)
FT4027 A157 copier	About 67 kg (147.7 lb)
FT4527 A160 copier	About 80 kg (176.4 lb)
FT4022 A161 copier	About 67 kg (147.7 lb)
FT4522 A162 copier	About 80 kg (176.4 lb)

Zoom: From 50% to 200% in 1% steps

Copying Speed (copies/minute):

	A4 sideways/ 11" x 8 1/2"	A3/11" x 17"	B4/8 1/2" x 14"
A153, and A156 copiers	35	20/19	22
A157, and A160 copiers	27	15/14	17
A161, and A162 copiers	22	12	-

Warm-Up Time

A153, and A156 copiers:
Less than 110 seconds (20°C)
A157, and A160 copiers:
Less than 80 seconds (20°C)
A161 and A162 copiers:
Less than 60 seconds (20°C)

First Copy Time:

Paper Feed Station	A4/11" x 8 1/2" (sideways)		
	A153, and A156 copiers	A157, and A160 copiers	A161, and A162 copiers
1st Tray	5.2 s (except for A156)	5.9 s (except for A160)	5.9 s (except for A162)
2nd Tray	5.7 s	6.6 s	6.6 s
By-pass	4.8 s	5.6 s	5.6 s
LCT	5.0 s	5.9 s	5.9 s

Note: In A156, A160 and A161 copiers, the 2nd tray in the above table is called the 1st tray (see Installation - Paper Feed Station Definition).

Copy Number Input: Ten-key pad, 1 to 999 (count up or count down)

Manual Image Density Selection: 7 steps

Automatic Reset: 1 minute is the standard setting; it can be changed to a maximum of 999 seconds or no auto reset by SP mode.

Copy Paper Capacity:

	Paper Tray	By-pass Feed	LCT
A153 copier	About 500 sheets x2	About 40 sheets	–
A156 copier	About 500 sheets x1	About 40 sheets	About 1000 sheets
A157 copier	About 250 sheets x2	About 40 sheets	–
A160 copier	About 250 sheets x1	About 40 sheets	About 1000 sheets
A161copier	About 250 sheets x2	About 40 sheets	–
A162 copier	About 250 sheets x1	About 40 sheets	About 1000 sheets

Duplex Tray Capacity [A156/A160/A162]: 50 sheets (30 sheets for A3/11"x17" 81 ~ 105g/m^2, 21.5 ~ 27.9 lb paper)

Toner Replenishment: Cartridge exchange (415 g/cartridge)

Toner Yield: 17K Copies/cartridge

Developer Replenishment: Type 1 (1kg bag)

Developer Yield: A153/A156 @ 120K copies
A157/A160 @ 100K copies
A161/A162 @ 100K copies

Optional Equipment:

- Platen cover
- Document feeder
- Paper tray unit with two paper trays
- Paper tray unit with three paper trays
- 10 bin micro sorter
- 20 bin mini sorter
- 10 bin sorter stapler
- 20 bin sorter stapler (Not used with A161 and A162)
- Sorter adapter (required when installing 20 bin mini sorter, 10 bin sorter stapler, or 20 bin sorter stapler for A157, A160, A161, and A162 copiers)
- Key counter
- Tray heater
- Optical anti-condensation heater
- Original length sensor for 11" x 15" size paper (only for LT/DLT version)
- ADS sensor for particular types of red original
- Zoom (10 Key) Function Decal *
- Margin Adjustment Function Decal *

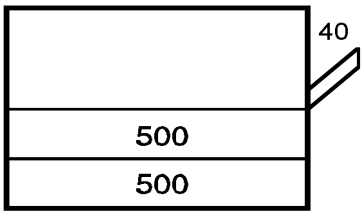
* Not used on FT4022/4522 (A161/A162 copiers)

2. MACHINE CONFIGURATION

2.1 COPIER

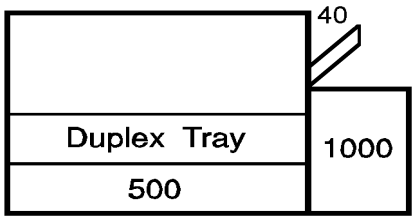
FT5035

A153 copier (Type 1)



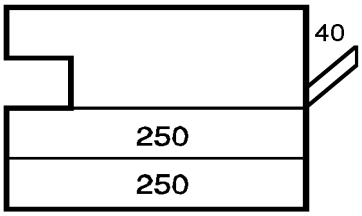
FT5535

A156 copier (Type 1)



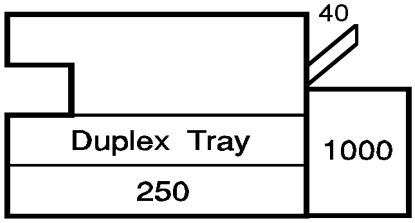
FT4027

A157 copier (Type 2)



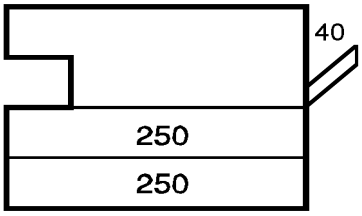
FT4527

A160 copier (Type 2)



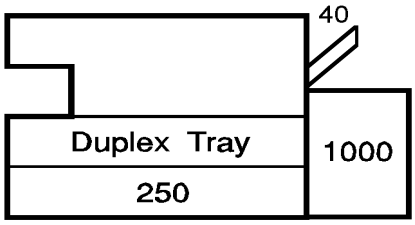
FT4022

A161 copier (Type 3)

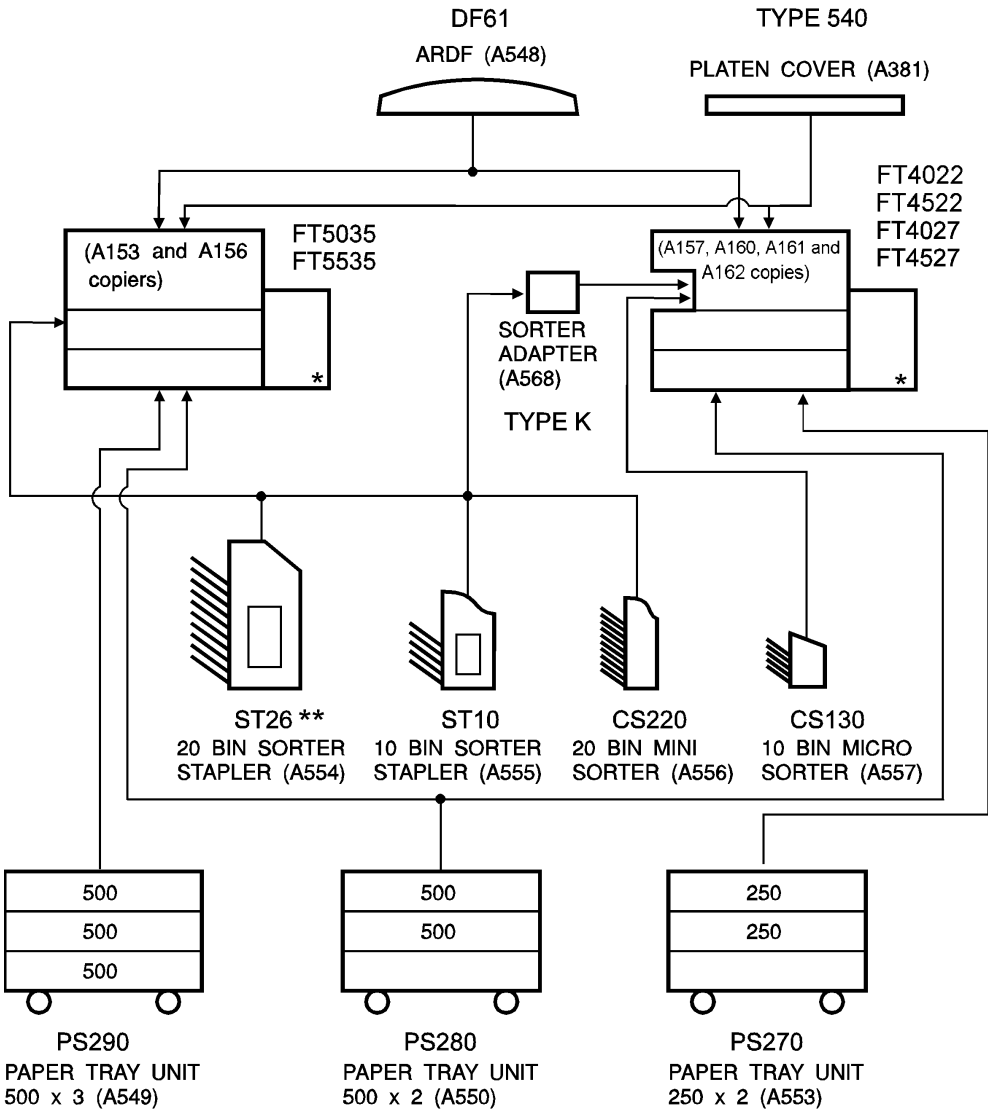


FT4522

A162 copier (Type 3)



2.2 OPTIONAL EQUIPMENT

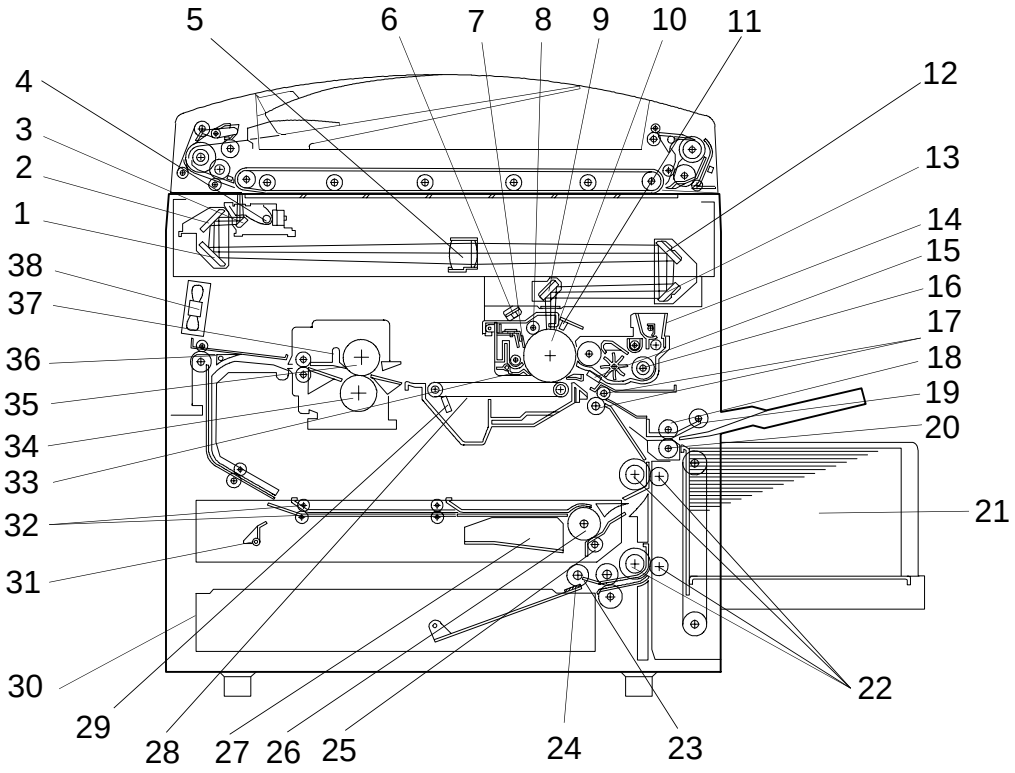


***** Only available on models FT5535, FT4527 and FT4522

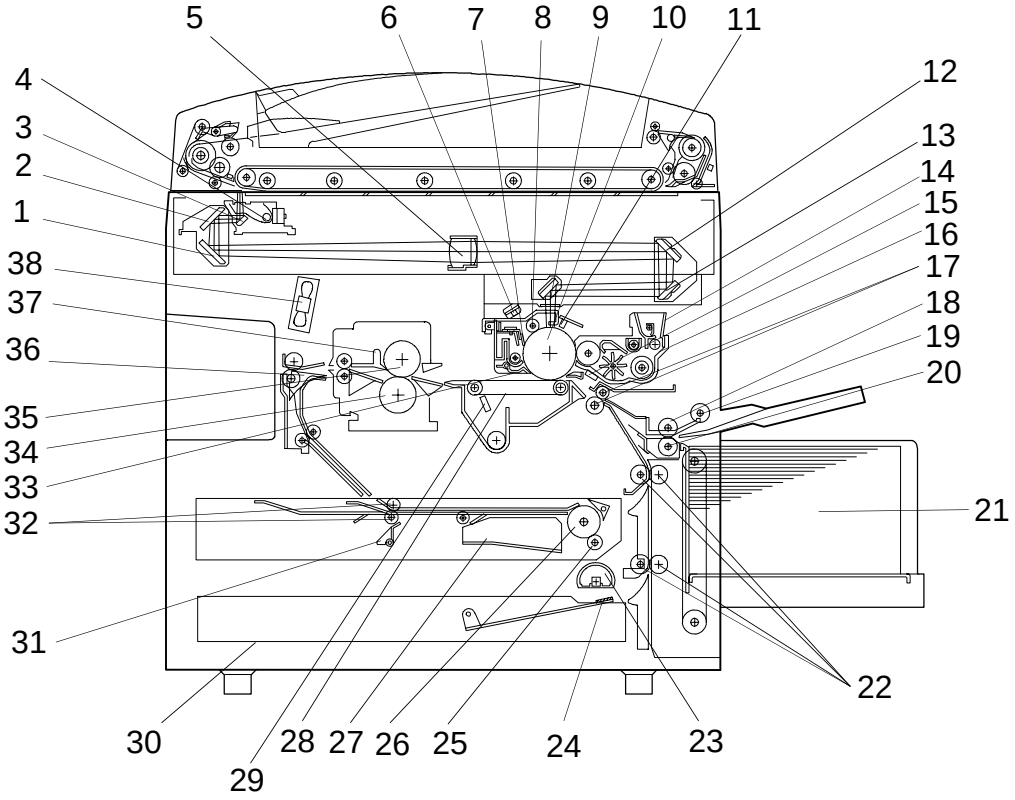
** Not for use on FT4022/4522 (A161/A162) copiers.

3. MECHANICAL COMPONENT LAYOUT

– A156 copier –



NOTE: The A153 copier is the same as the A156 copier except that the A153 does not have a duplex tray or an LCT.



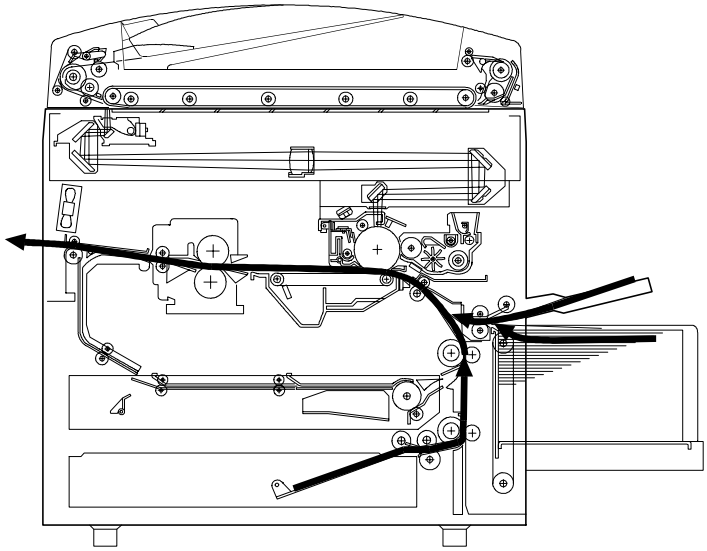
NOTE: The A157/A161 copiers are the same as the A160/A162 copiers except that the A157 and A161 do not have a duplex tray or an LCT.

1. 3rd Mirror
2. 2nd Mirror
3. 1st Mirror
4. Exposure Lamp
5. Lens
6. Quenching Lamp
7. Drum Cleaning Blade
8. Drum Charge Roller
9. 6th Mirror
10. OPC Drum
11. Erase Lamp
12. 4th Mirror
13. 5th Mirror
14. Toner Supply Unit
15. Pre-transfer Lamp
16. Development Unit
17. Registration Rollers
18. Feed Roller
19. Pick-up Roller
20. Separation Roller
21. Large Capacity Tray
22. Vertical Transport Rollers
23. Paper Feed Roller
    The roller for A153/A156 copiers is different from that for A157/160/161/162 copiers.
24. Friction Pad
25. Duplex Friction Roller
26. Duplex Feed Roller
27. Jogger Fence
28. Transfer Belt
29. Transfer Belt Cleaning Blade
30. Lower Paper Tray
31. End Fence
32. Entrance Rollers
33. Pick-off Pawls
34. Pressure Roller
35. Hot Roller
36. Junction Gate
37. Hot Roller Strippers
38. Transport Fan

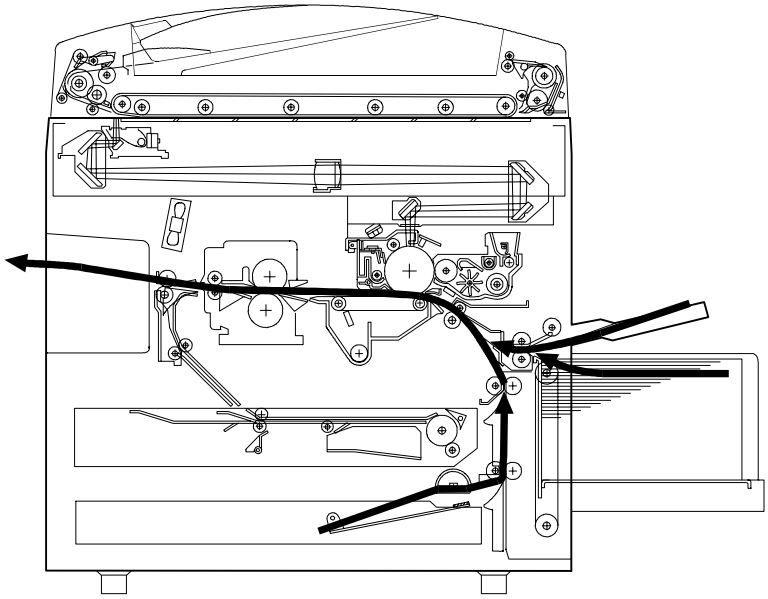
4. PAPER PATH

4.1 NORMAL COPYING

– A156 copier –

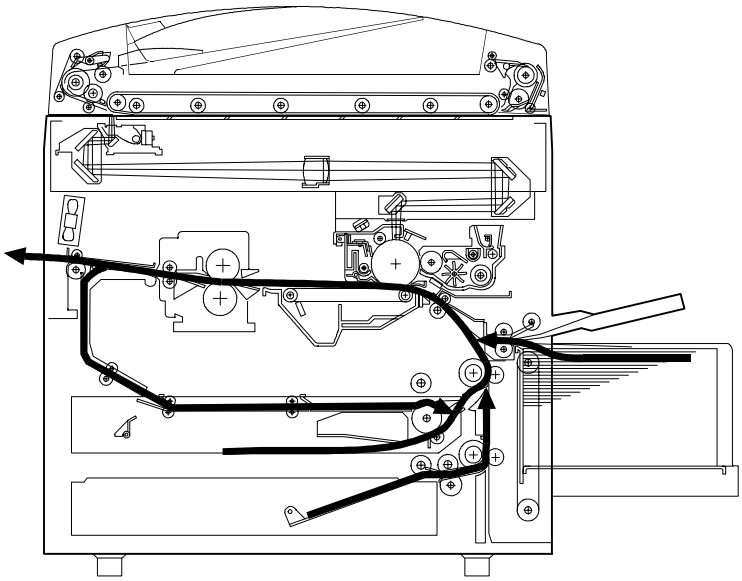


–A160/A162 copier –

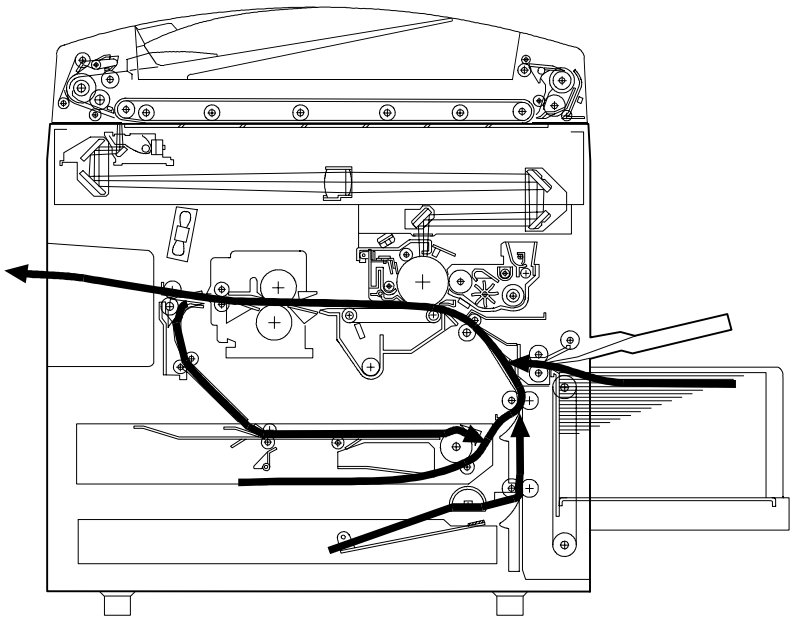


4.2 DUPLEX COPYING

– A156 copier –



– A160/A162 copier –



5. ELECTRICAL COMPONENT DESCRIPTIONS

Refer to the electrical component layout and the point to point diagram on the waterproof paper in the pocket for symbols and index numbers.

Symbol	Index No.	Description	Note
Printed Circuit Boards			
PCB1	14	Main Control	Controls all copier functions both directly or through other control boards.
PCB2	12	AC Drive	Provides ac power to the exposure lamp and fusing lamps.
PCB3	11	DC Power Supply	Provides dc power.
PCB4	96	Main Motor Control	Controls the rotation of the main motor.
PCB5	1	CB High Voltage Supply	Supplies high voltage to the drum charge roller and development roller.
PCB6	55	T High Voltage Supply	Supplies high voltage to the transfer belt.
PCB7	3	Operation Panel	Controls the LED matrix, and monitors the key matrix.
PCB8	8	Noise Filter (220 ~ 240 V machines only)	Removes electrical noise.
PCB9	63	Duplex Control (Duplex machines only)	Controls the operation of the duplex tray.
PCB10	6	Liquid Crystal Display (A156 machines only)	Controls the guidance display and displays guidance for machine operation.
PCB11	102	LCT Interface (LCT machines only)	Interfaces the LCT control signal between the main board and the LCT.
Motors			
M1	88	Main	Drives the main unit components.
M2	79	Toner Bottle Drive	Rotates the toner bottle to supply toner to the toner supply unit.
M3	97	Upper Tray Lift (A153 machines only)	Raises the bottom plate in the upper paper tray.
M4	86	Lower Tray Lift (A153/A156 machines only)	Raises the bottom plate in the lower paper tray.
M5	99	LCT Lift (LCT machines only)	Lifts up and lowers the LCT bottom plate.
M6	94	Optics Cooling Fan 1	Removes heat from the optics unit.
M7	95	Optics Cooling Fan 2 (A153/A156 machines only)	Removes heat from the optics unit.
M8	89	Exhaust Fan 1	Removes the heat from around the fusing unit.
M9	90	Exhaust Fan 2 (A153/A156 machines only)	Removes the heat from around the fusing unit.
M10	92	Scanner Drive	Drives the 1st and 2nd scanners (dc stepper motor).
M11	78	3rd Scanner Drive	Drives the 3rd scanner (dc stepper motor).
M12	87	Lens Vertical Drive	Shifts the lens vertical position.
M13	77	Lens Horizontal Drive	Shifts the lens horizontal position.
M14	58	Duplex Feed (Duplex machines only)	Drives the feed roller and moves the bottom plate up and down.
M15	61	End Fence Jogger (Duplex machines only)	Drives the end fence jogger to square the paper stack.

Symbol	Index No.	Description	Note
M16	60	Side Fence Jogger (Duplex machines only)	Drives the side fence jogger to square the paper stack.
Sensors			
S1	27	By-pass Feed Paper Width	Informs the CPU what width paper is in the by-pass feed table.
S2	31	By-pass Feed Paper End	Informs the CPU that there is no paper in the by-pass tray.
S3	51	Upper Tray Paper End (Non-duplex machines only)	Informs the CPU when the upper paper tray runs out of paper.
S4	107	Upper Relay	Detects the leading edge of paper from the upper tray to determine the stop timing of the upper paper feed clutch, **and detects misfeeds.**
S5	29	Upper Tray Upper Limit (A153 machines only)	Detects the height of the paper stack in the upper paper tray to stop the upper tray lift motor.
S6	52	Lower Tray Paper End	Informs the CPU when the lower paper tray runs out of paper.
S7	106	Lower Relay	Detects the leading edge of paper from the lower paper tray to determine the stop timing of the lower paper feed clutch, **and detects misfeeds.**
S8	30	Lower Tray Upper Limit (A153/A156 machines only)	Detects the height of the paper stack in the lower paper tray to stop the lower tray lift motor.
S9	100	LCT Lower Limit (LCT machines only)	Sends a signal to the CPU to stop lowering the LCT bottom plate.
S10	26	LCT Paper End (LCT machines only)	Informs the CPU when the LCT runs out of paper.
S11	28	LCT Upper Limit (LCT machines only)	Sends a signal to the CPU to stop lifting the LCT bottom plate.
S12	28	Registration	Detects the leading edge of the copy paper to determine the stop timing of the paper feed clutch, **and detects misfeeds.**
S13	50	Image Density (ID)	Detects the density of various patterns on the drum during process control.
S14	53	Toner Density (TD)	Detects the amount of toner inside the development unit.
S15	39	Lens Horizontal HP	Informs the CPU that the lens is at the horizontal home position.
S16	20	Lens Vertical HP	Informs the CPU that the lens is at the full-size position.
S17	15	Scanner HP	Informs the CPU when the 1st and 2nd scanners are at the home position.
S18	24	3rd Scanner HP	Informs the CPU when the 3rd scanner is at the home position.
S19	21	Original Length-2	Detects the length of the original. This is one of the APS (Auto Paper Select) sensors.
S20	45	Fusing Exit	**Detects misfeeds.**
S21	16	Platen Cover	Informs the CPU whether the platen cover is up or down (related to APS/ARE functions). ARE: Auto Reduce and Enlarge
S22	54	Toner End	Instructs the CPU to add toner to the toner supply unit, and detects toner end conditions.

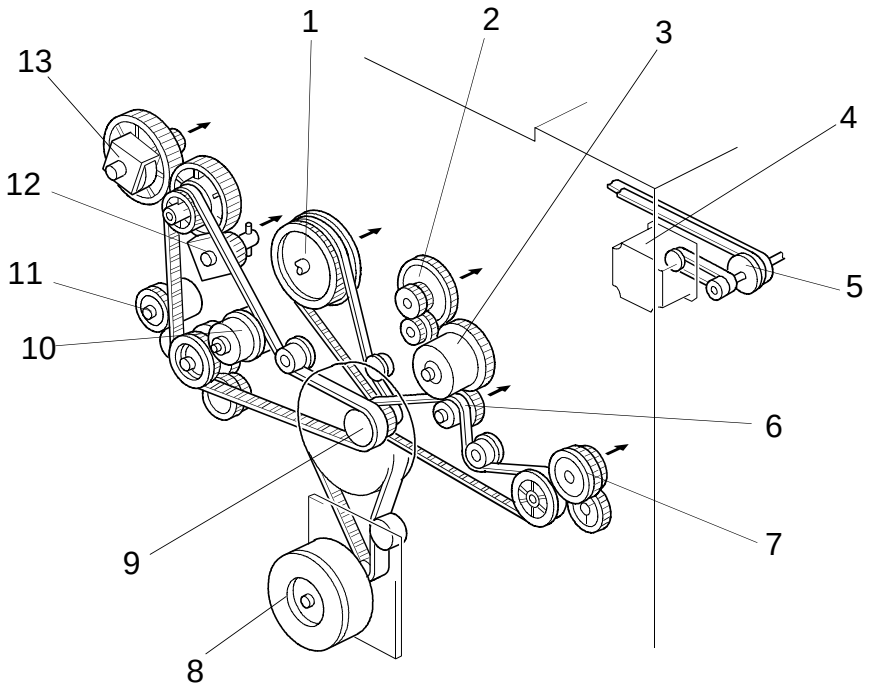
Symbol	Index No.	Description	Note
S23	43	Auto Response (Not used on A161/A162 copiers)	Returns the operation panel display and exits from the energy saver mode.
S24	23	Transfer Belt Contact HP	Informs the CPU of the current position of both the transfer belt unit and the drum charge roller unit.
S25	13	Auto Image Density (ADS Sensor)	Detects the background density of each original in ADS mode.
S26	44	Original Width	Detects the width of the original. This is one of the APS (Auto Paper Select) sensors.
S27	19	Original Length-1	Detects the length of the original. This is one of the APS (Auto Paper Select) sensors.
S28	56	Duplex Paper End (Duplex machines only)	Detects paper in the duplex tray.
S29	57	Duplex Turn (Duplex machines only)	Detects the trailing edge of the copy paper to determine the jogging timing, and detects misfeeds.
S30	62	Duplex Entrance (Duplex machines only)	**Detects misfeeds.**
S31	59	Side Fence Jogger HP (Duplex machines only)	Detects the home position of the duplex side fence jogger.
S32	64	End Fence Jogger HP (Duplex machines only)	Detects the home position of the duplex end fence jogger.
S33	22	Original Length (Option for N. American models)	Detects original length for 11" x 15" paper.
Switches			
SW1	33	By-pass Feed Table	Detects whether the by-pass feed table is open or closed.
SW2	36	Upper Tray (Non-duplex machines only)	Detects whether the upper paper tray is in place or not.
SW3	35	Lower Tray	Detects whether the lower paper tray is in place or not.
SW4	104	Tray Down (LCT machines only)	Sends a signal to the CPU to lower the LCT bottom plate.
SW5	25	Upper Tray Paper Size (Non-duplex machines only)	Determines what size of paper is in the upper paper tray.
SW6	34	Lower Tray Paper Size	Determines what size of paper is in the lower paper tray.
SW7	32	Vertical Guide Set (Non-LCT machines only)	Detects whether the vertical guide is open or not.
SW8	105	LCT Cover-1 (LCT machines only)	Detects whether the LCT cover is open or not.
SW9	103	LCT Cover-2 (LCT machines only)	Cuts the dc power line of the LCT lift motor.
SW10	42	Main	Supplies power to the copier.
SW11	41	Front Cover Safety	Detects whether the front door is open and via relays cuts the ac power.
SW12	48	Exit Cover Safety (A157/A160 machines only)	Detects whether the exit cover is open or not.

Symbol	Index No.	Description	Note
Magnetic Clutches			
CL1	72	Toner Supply	Turns the toner supply roller to supply toner to the development unit.
CL2	71	Development	Drives the development roller.
CL3	93	Transfer Belt Contact (1/3 Turn Clutch)	Controls the touch and release movement of both the transfer belt unit and the drum charge roller unit.
CL4	73	Registration	Drives the registration rollers.
CL5	74	By-pass Feed	Starts paper feed from the by-pass feed table or LCT.
CL6	76	Relay	Drives the relay rollers.
CL7	84	Upper Paper Feed (Non-duplex machines only)	Starts paper feed from the upper paper tray.
CL8	85	Lower Paper Feed	Starts paper feed from the lower paper tray.
Solenoids			
SOL1	75	LCT machines: LCT/By-Pass Pick-up Solenoid Non-LCT machines: By-pass Pick-up Solenoid	Picks paper up from the by-pass feed table. When paper is fed from the LCT, this solenoid assists SOL3.
SOL2	91	Junction Gate (Duplex machines only)	Moves the junction gate to direct copies to the duplex tray or to the paper exit.
SOL3	98	LCT Pick-up (LCT machines only)	Picks up paper from the LCT.
SOL4	80	Upper Tray Pick-up (A153/ machines only)	Controls the up/down movement of the pick-up roller in the upper paper tray.
SOL5	82	Lower Tray Pick-up (A153/A156 machines only)	Controls the up/down movement of the pick-up roller in the lower paper tray.
SOL6	81	Upper Tray Separation (A153/ machines only)	Controls the up-down movement of the separation roller in the upper paper tray feed station.
SOL7	83	Lower Tray Separation (A153/A156 machines only)	Controls the up-down movement of the separation roller in the lower paper tray feed station.
Lamps			
L1	17	Exposure	Applies high intensity light to the original for exposure.
L2	65	Main Fusing	Provides heat to the central area of the hot roller.
L3	66	Secondary Fusing	Provides heat to both ends of the hot roller.
L4	4	Pre-transfer	Reduces the charge remaining on the drum surface before transfer.
L5	5	Quenching	Neutralizes any charge remaining on the drum surface after cleaning.

Symbol	Index No.	Description	Note
L6	2	Erase	After exposure, this eliminates the charge on areas of the drum that will not be used for the image.
Heaters			
H1	38	Drum	Turns on when the main switch is off to keep the temperature around the drum charge roller at a certain level. Also prevents moisture from forming around the drum.
H2	46	Optics Anti-condensation (option)	Turns on when the main switch is off to prevent moisture from forming on the optics.
H3	37	Lower Tray (option)	Turns on when the main switch is off to keep paper dry in the lower paper tray.
Thermistors			
TH1	69	Main Fusing	Monitors the temperature at the central area of the hot roller.
TH2	70	Secondary Fusing	Monitors the temperature at the ends of the hot roller.
TH3	47	Optics	Monitors the temperature of the optics cavity.
TH4	49	Drum Charge	Monitors the temperature of the drum charge roller.
Thermofuses			
TF1	68	Main Fusing	Provides back-up overheat protection in the fusing unit.
TF2	67	Secondary Fusing	Provides back-up overheat protection in the fusing unit.
TF3	18	Exposure Lamp	Opens the exposure lamp circuit if the 1st scanner overheats.
Counters			
CO1	40	Total	Keeps track of the total number of copies made.
CO2	N/A	Key (option)	Used for control of authorized use. The copier will not operate until it is installed.
Others			
CB1	9	Circuit Breaker (220 ~ 240V machines only)	Provides back-up high current protection for electrical components.
CC1	10	Choke Coil (220 ~ 240V machines only)	Removes high frequency current.
TR1	7	Transformer (220 ~ 240V machines only)	Steps down the wall voltage to 100 Vac.

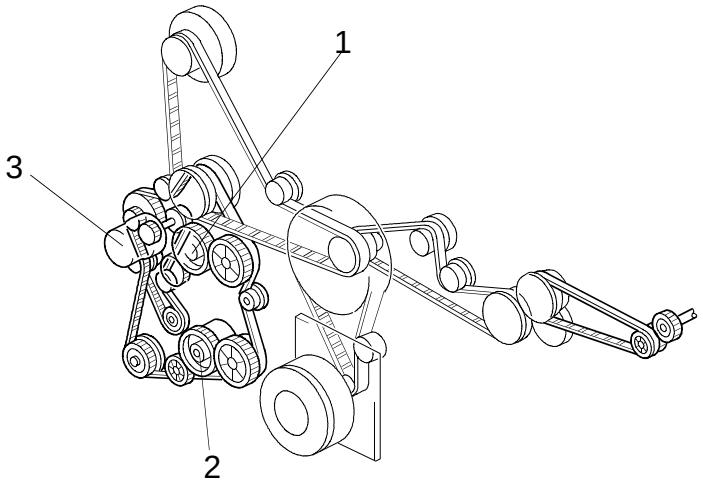
6. DRIVE LAYOUT

6.1 ALL MODELS



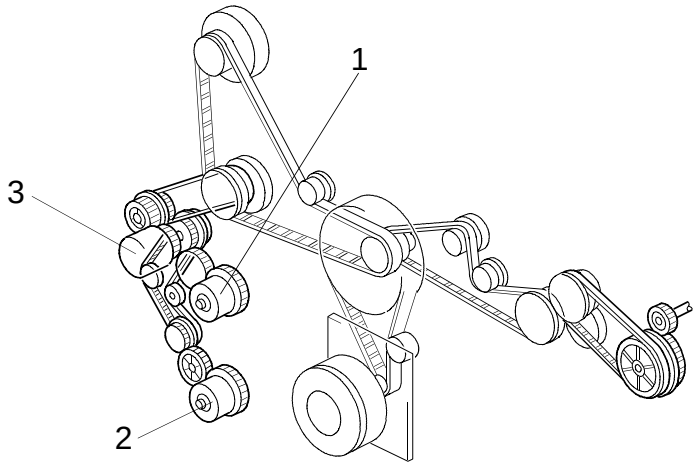
1. Drum Drive Pulley
2. Drum Charge Roller Drive Gear
3. Transfer Belt Contact Clutch Gear
4. Scanner Drive Motor
5. Scanner Drive Pulley
6. Transfer Belt Drive Gear
7. Fusing Unit Drive Gear
8. Main Motor
9. Main Pulley
10. Registration Clutch Gear
11. By-pass Feed Clutch Gear
12. Development Drive Clutch Gear
13. Toner Supply Clutch Gear

6.2 A153/A156



1. Upper Paper Feed Clutch Gear (A153 only)
2. Lower Paper Feed Clutch Gear
3. Relay Clutch Gear

6.3 A157/A160/A161/A162



1. Upper Paper Feed Clutch Gear (A157 and A161 only)
2. Lower Paper Feed Clutch Gear
3. Relay Clutch Gear

DETAILED DESCRIPTIONS

1. PROCESS CONTROL

1.1 OVERVIEW

1.1.1 Copy Process around the Drum

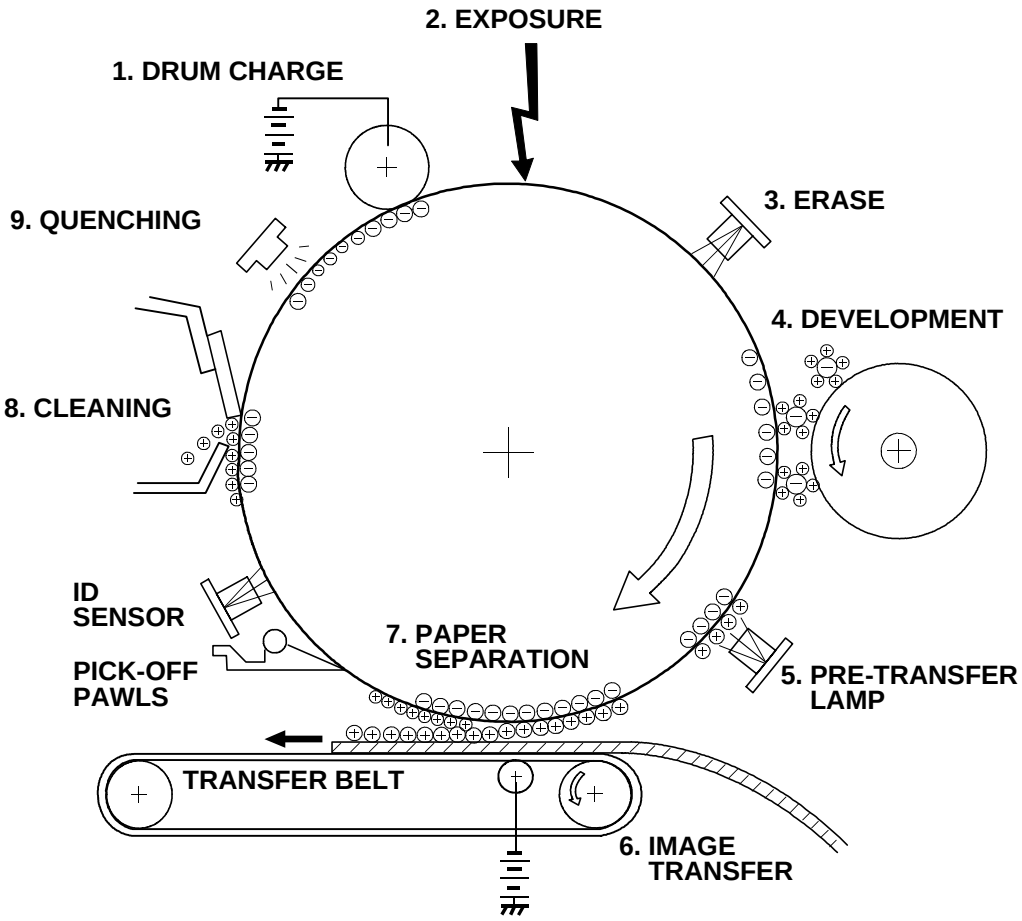


Fig. 1 Copy Process Around the Drum

1. DRUM CHARGE

In the dark, the drum charge roller gives a uniform negative charge to the organic photo-conductive (OPC) drum. The charge remains on the surface of the drum because the OPC layer has a high electrical resistance in the dark. The amount of negative charge on the drum is proportional to the negative voltage applied to the drum charge roller.

2. EXPOSURE

An image of the original is reflected onto the OPC drum surface via the optics assembly. The charge on the drum surface is dissipated in direct proportion to the intensity of the reflected light, thus producing an electrical latent image on the drum surface.

The amount of remaining charge as a latent image on the drum depends on the exposure lamp intensity, which is controlled by the exposure lamp voltage.

3. ERASE

The erase lamp illuminates the areas of the charged drum surface that will not be used for the copy image. The resistance of the drum in the illuminated areas drops and the charge on those areas dissipates.

4. DEVELOPMENT

As a result of the development potential (the difference of charged voltage between the drum and the toner), toner is attracted to the areas of the drum where the negative charge is greater than that of the toner, and the latent image is developed.

The development bias voltage applied to the development roller shaft controls two things:

1) The threshold level for whether toner is attracted to the drum or whether it remains on the development roller.
2) The amount of toner to be attracted to the drum.

The higher the negative development bias voltage is, the less toner is attracted to the drum surface.

5. PRE-TRANSFER LAMP (PTL)

The PTL illuminates the drum to remove almost all the negative charge from the exposed areas of the drum. This prevents the toner particles from being reattracted to the drum surface during paper separation and makes paper separation easier.

6. IMAGE TRANSFER

Paper is fed to the area between the drum surface and the transfer belt at the proper time so as to align the copy paper and the developed image on the drum surface. Then, the transfer bias roller applies a strong negative charge to the reverse side of the copy paper through the transfer belt. This negative charge produces an electrical force which pulls the toner particles from the drum surface on to the copy paper. At the same time, the copy paper is electrically attracted to the transfer belt.

7. PAPER SEPARATION

Paper separates from the OPC drum as a result of the electrical attraction between the paper and the transfer belt. The pick-off pawls help separate the paper from the drum.

8. CLEANING

The cleaning blade removes toner remaining on the drum after the image is transferred to the paper.

9. QUENCHING

Light from the quenching lamp electrically neutralizes the charge on the drum surface.

1.1.2 Factors Affecting Process Control

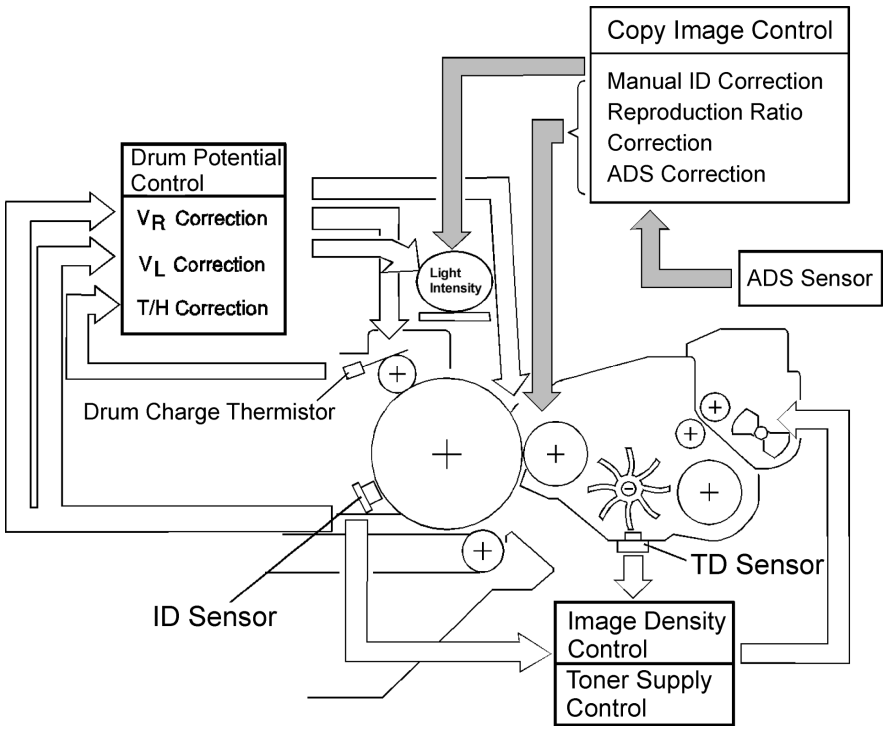


Fig. 2 Process Control

In this copier, the following items are controlled during the copy process to maintain good copy quality:

- Exposure lamp voltage
- Drum charge roller voltage
- Development bias voltage
- Toner supply

The machine controls the items listed above by monitoring the following electrical components:

- Operation panel (manual ID selection and reproduction ratio)
- ADS sensor
- TD sensor
- ID sensor
- Drum charge thermistor
- Paper size detectors
- RAM board (drum rotation time, SP mode data, and paper size data)

1.1.3 Process Control Procedures

This section outlines how the machine controls the copy process based on the inputs from various sensors.

1.1.3.1 Copy Image Control

This is how the machine adjusts copy processes based on settings input at the operation panel.

- Manual ID Correction -

If the user inputs the image density manually, the machine adjusts the exposure lamp voltage and the development bias to achieve the selected image density.

- Reproduction Ratio Correction -

If the user selects a 116% or greater enlargement ratio or a 50% reduction ratio, the machine corrects the development bias to compensate for the loss in light intensity reaching the drum.

- ADS Pattern Detection and ADS Correction -

If the user selects Auto Image Density (ADS) mode, the machine monitors the output from the ADS sensor and adjusts the development bias to compensate for variations in ADS sensor response. This prevents dirty background.

Every 1,000 copies, the machine calibrates the ADS sensor output by reading the white ADS pattern under the left scale of the exposure glass.

The ADS sensor must also be recalibrated:
- If the drum is changed
- If the ADS sensor is cleaned or changed
- If the exposure lamp or optics are cleaned or changed.

1.1.3.2 Image Density Control

This is how the machine corrects the concentration of toner in the developer based on readings from the ID (Image Density) and TD (Toner Density) sensors.

- V_{SP} and V_{SG} Detection/ID Correction -

The machine uses V_{SP} and V_{SG} readings by the ID sensor, along with readings from the toner density sensor, to determine if the toner concentration in the developer is at the optimum level.

The amount of toner supplied to the V_{SP} pattern must remain constant. To ensure this, the machine applies a correction to the development bias for V_{SP} patterns when combined readings from the TD and ID sensors indicate that the carrier is aging. This correction is called "ID Correction".

- Toner Supply -

There are three toner supply modes.

Detect toner supply: Toner supply varies with paper size, the latest TD sensor reading, and the latest V_{SP} and V_{SG} readings by the ID sensor. For example, toner supply will be increased if the toner weight ratio in the developer is decreasing, or if the most recent V_{SP} pattern was detected as being relatively light.

Fixed supply mode: The toner supply remains constant, but can be adjusted with an SP mode.

TD supply mode: Toner supply varies with TD sensor output. For example, if the toner weight ratio has decreased since TD sensor supply mode was selected, toner supply is increased.

1.1.3.3 Drum Potential Control

This is how the machine compensates for aging of the drum and the exposure lamp, and for the temperature around the drum charge roller.

- V_R Pattern Detection and V_R Correction -

As the drum gets older, the drum's residual voltage gradually increases due to electrical fatigue. Light from the exposure lamp will not dissipate the increased residual voltage effectively and dirty background will result.

Every 1,000 copies, part of the drum is developed with the V_R pattern development bias. If there is residual voltage on the drum, this area of the drum will attract some toner, making a V_R pattern. The ID sensor response to this pattern is compared with the response of the ID sensor to a bare area of the drum. The higher the residual voltage on the drum is, the darker the V_R pattern is. If the pattern is too dark, the drum will not be discharged sufficiently. As a result, the machine will increase the negative development bias to prevent dirty background. If it does, image density will drop. To prevent this, the machine will also increase the negative drum charge roller voltage.

(The V_{RP}/V_{RG} range to which the above mentioned bias and charge corrections are applied may be shifted to cancel the effect of ID correction.)

V_R correction data must be reset by SP mode (forced V_R detection) if the drum is changed or if the ID sensor is cleaned or replaced.

- V_L Pattern Detection and V_L Correction -

This is how the machine adjusts the exposure lamp voltage to compensate for the effects of drum wear, dirty optics, and response of the drum to light.

Every 1,000 copies, an image of the V_L pattern under the left scale bracket is made on the drum. The machine compares the response of the ID sensor to this image with the response to a bare area of the drum.

The exposure lamp voltage is adjusted if there have been significant changes from the measurements made from when a new drum or lamp was installed.

(The V_{LP}/V_{LG} range to which the above mentioned lamp voltage adjustment is applied may be shifted to cancel the effect of ID correction.)

Initial V_{LP}/V_{LG} detection must be done by SP mode if a new drum is installed or if the exposure lamp is cleaned or replaced.

- T/H Correction -

The efficiency of the transfer of charge from the drum charge roller to the drum varies with the temperature near the drum charge roller. Also, the drum potential after charging varies with the accumulated rotation time of the drum.

A thermistor measures the temperature near the drum charge roller, and the CPU keeps track of how long the drum has been rotating.

The machine adjusts the drum charge roller voltage depending on the temperature and accumulated rotation time.

This section has provided an overview of all the process control procedures done by the machine. The next few pages will explain each of these in more detail. At the end, there will be a summary.

1.2 COPY IMAGE CONTROL

Copy image control adjusts the development bias and exposure lamp voltage to take account of the reproduction ratio and image density. The image density is either selected by the user or detected automatically.

1.2.1 Manual ID Correction

If the user selects the image density manually, the selected manual ID level affects the exposure lamp voltage and the development bias as follows.

- Exposure Lamp Voltage -

As the ID level increases from 1 to 7, the exposure lamp voltage is increased as shown in the following table.

Table 1. Exposure lamp voltage control by manual ID level

ID Level	Lamp Voltage
1	Vexp –4.0 V
2	Vexp –3.0 V
3	Vexp –1.5 V
4	Vexp ±0.0 V
5	Vexp +1.5 V
6	Vexp +4.0 V
7	Vexp +6.0 V

Vexp = Lamp voltage selected with SP4-001. It can be between 50 and 75 V. It is factory set, and varies from copier to copier.

- Development Bias -

The greater the negative voltage, the paler the image on the drum. However, the development bias is adjusted only at the extreme light and dark ends of the manual ID range.

Table 2. Development bias control by manual ID level

ID Level	Development Bias
1	+80 V
2	±0 V
3	±0 V
4	±0 V
5	±0 V
6	±0 V
7	SP2-201-002 (see below)

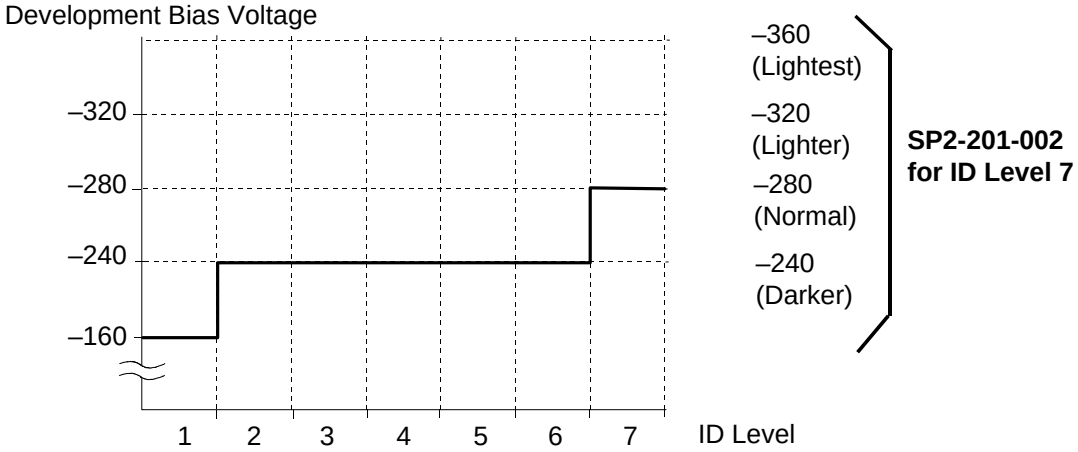
Note: The base development bias voltage is -240 Volts.

For ID Level 7 (lightest copies), there are four possible development bias correction settings that can be selected with SP2-201-002, as shown below.

Table 3. Lightest ID level development bias (ID Level 7)

SP2-201-002 Setting	Density	Dev. Bias Correction Voltage
1 (Factory Setting)	Normal	–40 V
2	Dark	±0 V
3	Lighter	–80 V
4	Lightest	–120 V

In summary, the development bias at various ID level settings is shown below.



1.2.2 Reproduction Ratio Correction

At reproduction ratios of 50% and 116% or greater, the intensity of light reaching the drum from the original drops significantly, which could cause copies to become underexposed (too dark).

To compensate for this, a development bias correction voltage is applied as shown in Table 4. This correction increases the development bias voltage, restoring the copy image density to normal.

Table 4. Reproduction ratio correction

Reproduction Ratio (%)	Development Bias Correction Voltage
181 ~ 200	–100 V
161 ~ 180	–80 V
142 ~ 160	–60 V
123 ~ 141	–40 V
116 ~ 122	–20 V
51 ~ 115	±0 V
50	–30 V

1.2.3 ADS Correction

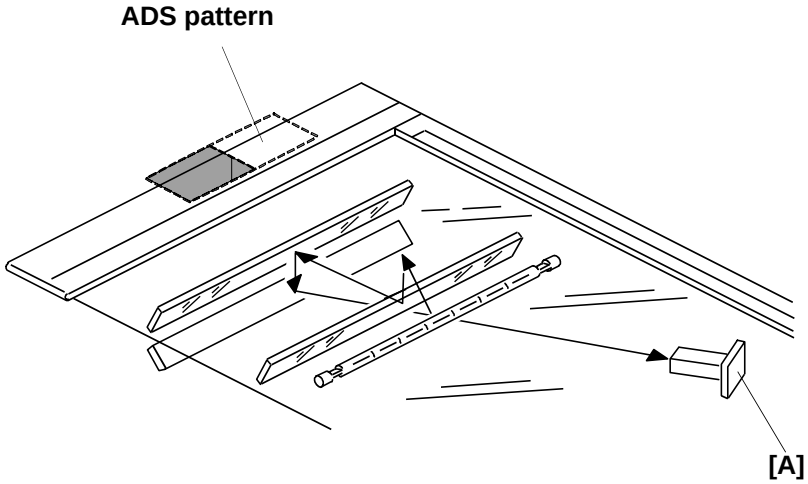


Fig. 3 ADS pattern

If the user selects Auto Image Density (ADS) mode, the output of the ADS sensor is used to correct the development bias; the exposure lamp voltage is kept at the setting for ID level 4 and is not adjusted.

In ADS mode, the ADS sensor [A] detects the original background density. To prevent dirty background from appearing on copies, the CPU corrects the development bias voltage for the original. To do this, it compares the ADS sensor output from the original [V_{ADS} (original)] with a stored reference value [V_{ADS} (pattern)] that was taken earlier from the ADS sensor pattern. The correction is shown in table 5, and is applied every copy.

Table 5. ADS data correction

ADS Density SP5-106		**Development Bias Correction Voltage**
Setting	**Copy Density**	
0	Darker	816 x (AR – 0.79)
1	Normal	816 x (AR – 0.85)
2	Lighter	816 x (AR – 0.95)

Where AR (ADS Ratio) = V_{ADS} (original)/V_{ADS} (pattern)

Note that there are three possible corrections. The default setting is 1 (normal). However, for example, if the user requires copies to be darker when using ADS mode, a technician can set SP5-106 to 0.

V_{ADS} (pattern) is checked every 1,000 copies. (See process control checks at every 1,000 copies on p2-29.) It is kept at 2.7±0.1 volts by a gain adjustment.

See the "Optics - Automatic Image Density Control System (ADS)" section for more details on how the ADS sensor measures the background and on how [V_{ADS} (pattern)] is corrected every 1,000 copies.

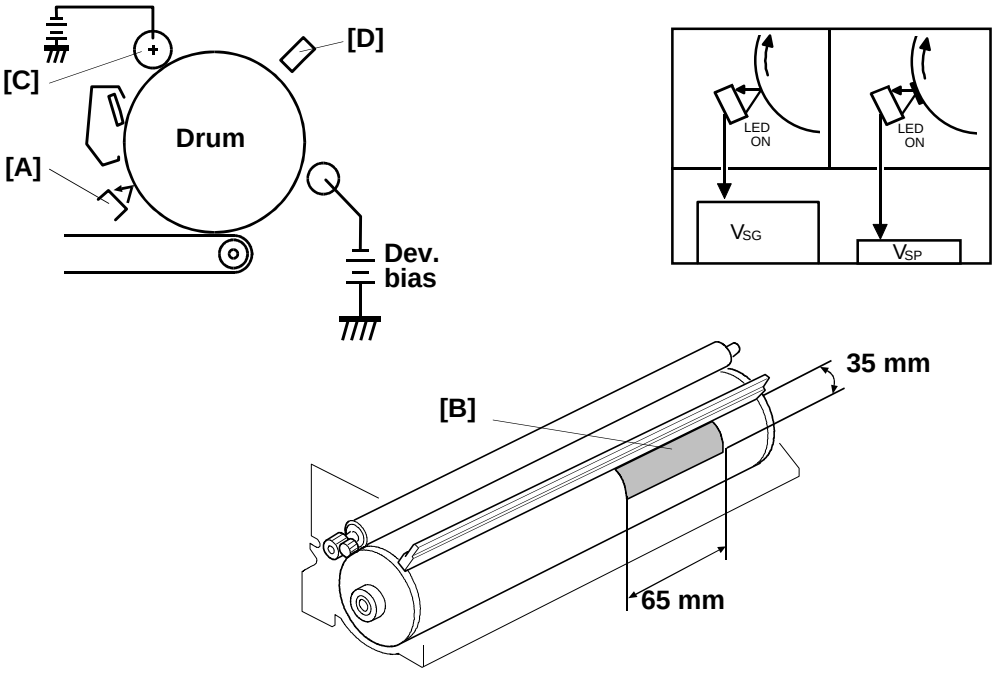
1.3 IMAGE DENSITY CONTROL

1.3.1 Overview

The machine controls the toner supply mechanism using the toner density sensor (TD sensor) and the image density sensor (ID sensor).

Readings from the TD sensor are used to keep the toner concentration in the developer at a constant level. However, the image on the OPC drum varies due to the variation in toner chargeability, which is influenced by the environment, even if the toner concentration is constant. Because of this, readings from the ID sensor are used to change the toner concentration to keep the image density on the OPC drum constant.

1.3.2 V_{SP} and V_{SG} Detection

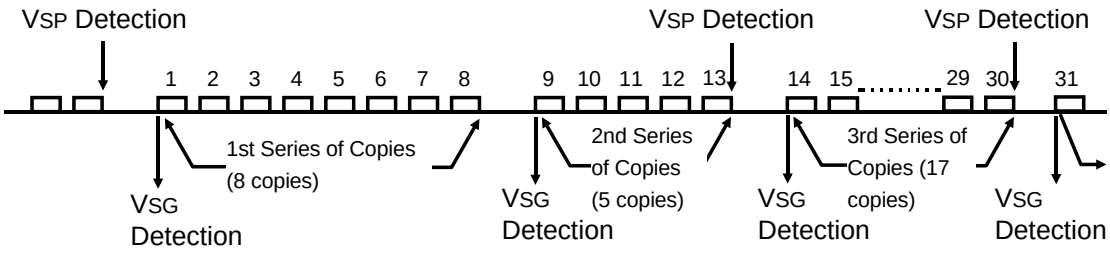


The ID sensor [A] (below the drum cleaning section) checks the following voltages.

- V_{SG}: the ID sensor output when checking the erased drum surface.
- V_{SP}: the ID sensor output when checking the Vsp pattern image.

In this way, the reflectivity of both the erased drum surface and the pattern on the drum are checked. This compensates for any variations in light intensity from the LED component of the sensor or the reflectivity of the drum.

The V_{SP} pattern [B] is made on the OPC drum by the drum charge roller [C] and the erase lamp [D].



- VSG is measured at the start of every copy run.
- VSP is detected at the end of a copy run if 10 or more copies have been made since VSP was last measured. The transfer belt must be released to measure VSP, so it cannot be checked during a copy run.

1.3.3 ID Correction for the VSP Pattern

Background

Developer consists of carrier particles (ferrite and resin) and toner particles (resin and carbon). The positive triboelectric charge on the toner is caused by friction between the carrier and toner particles. However, the chargeability of carrier decreases with time. Therefore, if the toner weight ratio in the developer is the same, the amount of positive triboelectric charge for one particle of toner decreases. This is because the number of toner particles which surround one carrier particle is the same, but the chargeability of one particle of carrier is less than before.

If the development potential, that is, the difference of voltage between the development roller and the drum for the VSP pattern is the same, more toner particles are attracted to the VSP pattern, because one particle of toner has less positive charge than before. (More toner particles are required to balance the charge of the VSP pattern.)

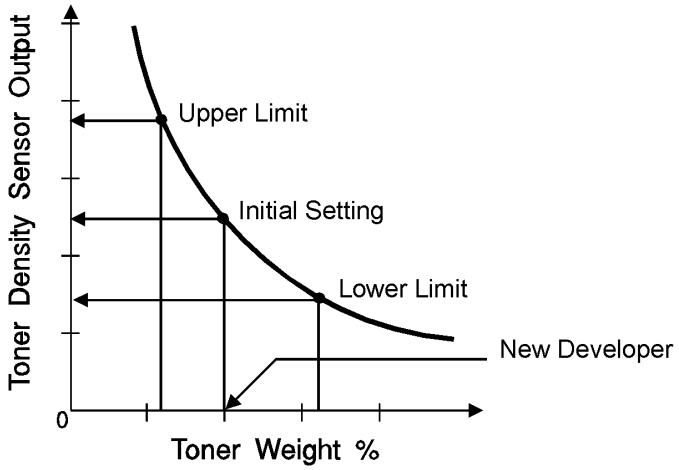
If the ID sensor were to check the VSP pattern's reflectivity under this condition, the VSP pattern would be darker than before. The CPU would then incorrectly conclude that the toner weight ratio in the developer is too high even though the ratio actually remains the same. The CPU would then decrease the toner clutch on time, leading to a low percentage of toner in the developer by weight as the copy count rises.

If uncontrolled, this would cause some side effects, such as low image density or developer adhering to the copy. To prevent these side effects, ID correction is done when the VSP pattern is made.

The idea behind ID correction is to cancel the effect on the VSP pattern of the decrease in the chargability of carrier with time. ID correction is done by changing the development bias for the VSP pattern so that it has the same darkness even though the chargeability of the carrier has changed.

ID Correction Method

The machine determines whether the development bias needs adjusting by monitoring the density of the toner/carrier mixture in the development unit. When the toner weight ratio in the developer changes, the voltage output by the TD sensor changes accordingly. The smaller the toner weight ratio in the developer is, the greater the TD sensor output is, as shown in the diagram below.



When new developer with the standard concentration (2.0% by weight, 20 g of toner in 1,000 g of developer) is installed, the TD sensor initial setting must be done with SP mode 2-214. This sets the sensor output to 2.5 ± 0.1 V.

As shown earlier, the chargeability of carrier in the developer decreases with the copy count. If no correction is done, the CPU tries to decrease the toner weight ratio in the developer. So this eventually causes the reading from the TD sensor to exceed its maximum acceptable value (initial value + 1.0 V).

If the corrected TD sensor output VTREF exceeds the upper limit over 100 times continuously, development bias for the VSP pattern is corrected. VTREF is the current TD sensor output with a correction factor included that is based on the VSP/VSG ratio from the ID sensor (see VSP and VSG Detection) calculated every 10 copies or so (see Toner Supply Control - Detect Supply Mode for more about VTREF).

The first time this happens, the correction is -40 V. If the upper limit is exceeded 100 consecutive times again later, an extra -40 V correction is applied (see the following table). There should be no need for further steps, because the toner proportion by weight will stabilize before this.

Table 6. ID correction

Step	Development Bias Correction for the V_{SP} Pattern
Initial	0 V
1st	–40 V
2nd	–80 V

If no correction is applied, the charge on the drum for the V_{SP} pattern is –600 V, and the development bias for the V_{SP} pattern is –300 V. So there is a difference of 300 V between the development roller and the drum for the V_{SP} pattern.

When the ID correction is applied, the voltage difference is reduced. For example, if a –40 V ID correction is applied, the difference in voltage is:

Before ID Correction: –300 – (–600) = 300 V
After ID Correction: –300 **– 40** – (–600) = 260 V

As a result, the effect of the change in chargeability of the carrier particles is canceled. The darkness of the V_{SP} pattern returns to normal.

1.3.4 Toner Supply Control During Copying

There are three modes for controlling the toner supply.

- Detect supply mode
- Fixed supply mode
- TD sensor supply mode

The mode can be selected with SP2-208-001. The factory setting is detect supply mode.

Toner clutch on time is calculated by the following formula.

$$\text{Toner CL on time [ms]} = \frac{\mathbf{S \times AT \times TSC / 100}}{\mathbf{TS}} \qquad \text{(Formula 1)}$$

where: S = Copy paper size [cm^2]
AT = Amount of toner developed on the latent image per unit area
= 0.7 [mg/cm^2] (constant)
TSC = Toner supply coefficient [%]
TS = Amount of toner supplied per unit of time
= 0.183 [mg/ms] (for A153, A155, and A156 copiers)
= 0.133 [mg/ms] (for A157, A159, and A160 copiers)

AT and TS are constant, and S depends only on paper size, but TSC is determined in different ways depending on which toner supply mode is in use.

Determination of TSC

TSC is an estimate of the proportion of black area in the image that is made by the machine.

(1) Detect Supply Mode

In detect supply mode, TSC is determined from outputs from both the TD and ID sensors, in conjunction with the toner supply ratio that has been selected for this mode.

- Toner Supply Ratio -

This is selected with SP2-222. The settings are 1 (7%), 2 (15%), 3 (30%), or 4 (60%). The default is 15%.

- TD and ID Sensor Outputs -

The machine calculates a value for V_T-V_{TREF}.

- V_T: Current TD sensor output
- V_{TREF}: TD sensor output at the latest V_{SP} detection corrected for ID sensor output (V_{SP}/V_{SG}); this is calculated every 10 or so copies (see V_{SP}/V_{SG} Detection for more on V_{SP} and V_{SG}).

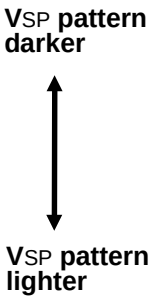
V_{TREF} is determined as follows.

$V_{TREF} = V_{TP} + \Delta V_{REF}$ (Formula 2)

- V_{TP} = TD sensor output at V_{SP} detection
- ΔV_{REF} = Correction factor based on V_{SP}/V_{SG} (from the ID sensor output), determined by the following table.

Table 7.

V_{SP}/V_{SG}	ΔV_{REF} [V]
~ 0.075	+4 x 0.0196
0.076 ~ 0.090	+2 x 0.0196
0.091 ~ 0.105	±0
0.106 ~ 0.125	–2 x 0.0196
0.126 ~ 0.160	–4 x 0.0196
0.161 ~ 0.205	–6 x 0.0196
0.206 ~ 0.500	–8 x 0.0196
0.501 ~	The previous V_{TREF}



TSC [%] is then determined from V_T-V_{TREF} and the toner supply ratio, as shown by table 8.

Table 8. Toner Supply Coefficient (%)

(V_T-V_{TREF}) /0.0196	Supply Ratio (SP Mode Setting)			
	7%	15%	30%	60%
~ 0	0	0	0	0
1 ~ 3	7	15	30	60
4 ~ 5	15	30	45	60
6 ~ 7	30	45	60	60
8 ~	60	60	60	60

For example, if the toner supply ratio is 15% and $(V_T-V_{TREF})/0.0196$ is 4.5, TSC is 30. This value is then used in the formula to determine the toner supply clutch on time given at the start of this discussion. (See formula 1.)

This all means that, if the ID sensor reading indicated that the most recent V_{SP} pattern was relatively light, the toner supply clutch will stay on for longer. (If V_{SP}/V_{SG} is higher, ΔV_{REF} is smaller [Table 7]. This means that V_{TREF} is smaller [Formula 2], leading to a larger V_T-V_{TREF}. So, for a particular toner supply ratio, the TSC value will be higher [Table 8], so the clutch stays on for longer [Formula 1].)

(2) Fixed Supply Mode

TSC [%] is fixed. It is selected with SP mode 2-208-003 as shown below.

Table 9. Toner Supply Coefficient (%)

	SP2-208-003 Value			
	1	2	3	4
TSC [%]	2	4	6	11

NOTE: Default = 6%

The machine automatically switches to fixed supply mode if the ID or TD sensor fail (see section 1.3.5.).

(3) TD Sensor Supply Mode

TSC [%] is determined as shown in Table 8 for detect supply mode. However, the toner supply ratio and $V_T - V_{TREF}$ are both determined in different ways. In particular, the ID sensor output is ignored.

- Toner Supply Ratio -

The supply ratio is selected with SP2-208-002. The settings are 1 (7%), 2 (15%), 3 (30%), or 4 (60%). The default is 15%.

- $V_T - V_{TREF}$ -

- V_{TREF} = V_{TREF} at the moment that TD sensor supply mode was selected.
- V_T = Current TD sensor output

1.3.5 Toner Supply in Abnormal Sensor Conditions

If any sensor errors occur under detect supply mode, toner supply mode is changed automatically as shown below.

Table 10.

Error	Abnormal Condition	Fallback Toner Supply Mode	Display on Operation Panel
ID Sensor Adjustment Error	When ID sensor output cannot be adjusted to 4.0 ± 0.2 V	Fixed Supply Mode	None
Abnormal ID Sensor (V_{SP})	If V_{SP} > 2.5 V during V_{SP} detection.	Fixed Supply Mode	None
Abnormal ID Sensor (V_{SG})	If V_{SG} < 2.5 V during V_{SG} detection	Fixed Supply Mode	
TD Sensor Adjustment Error	When TD sensor output cannot be adjusted to 2.5 ± 0.1 V	Fixed Supply Mode	Manual ID level or ADS indicator blinks
TD Sensor (V_T) Measurement Error	If V_T > 4.0 V or V_T < 0.3 V during V_T detection.	Fixed Supply Mode	Manual ID level or ADS indicator blinks
Drum Charge Thermistor Error	Temperature detected by the drum charge thermistor is below 0°C or above 60°C	Fixed Supply Mode	None
Abnormal Drum Charge Thermistor Output	Temperature detected by the drum charge thermistor (T) is between 0 °C and 20°C	TD Sensor Supply Mode	None

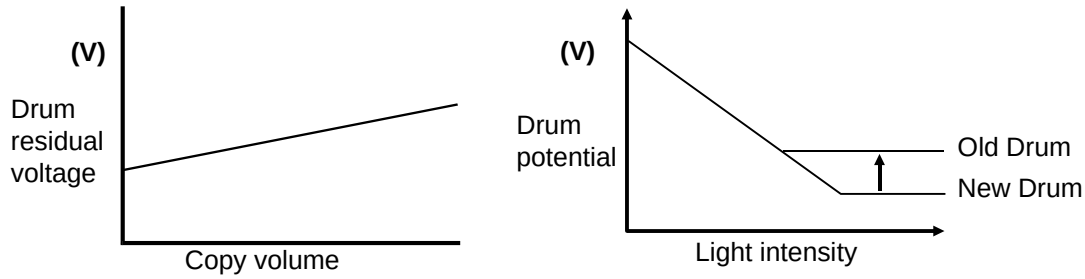
NOTE: No indication is displayed under the "abnormal drum charge thermistor output" condition, because the machine soon recovers due to the heat inside the machine.

1.4 DRUM POTENTIAL CONTROL

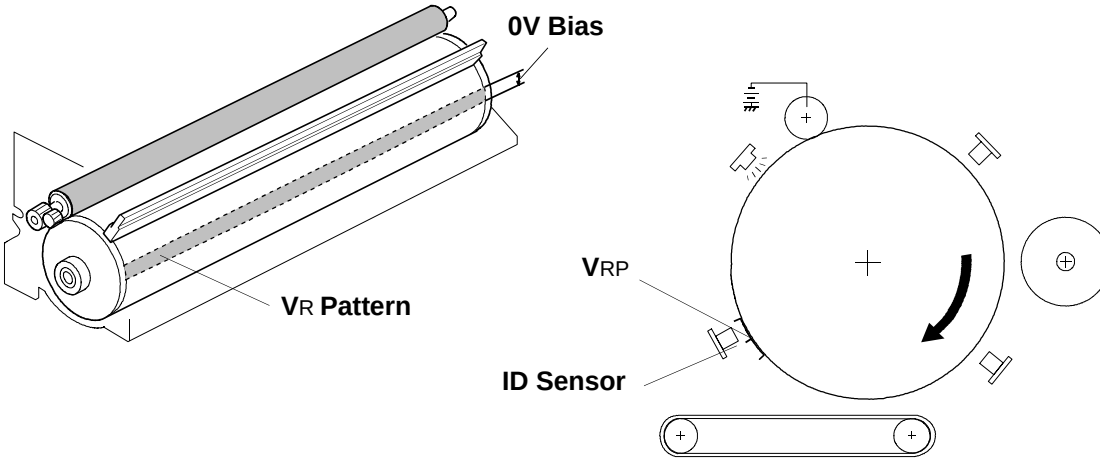
The characteristics of the drum vary with the temperature around the drum, and they change as the drum gets older. To take account of these and other related factors, this machine has the following three drum potential control routines.

- VR pattern correction
- VL pattern correction
- T/H correction

1.4.1 VR Pattern Correction



As the drum ages, the drum residual voltage gradually increases due to electrical fatigue (see the upper left chart). In other words, as the drum gets older, light does not discharge it as much (see the upper right chart). This may cause dirty background on copies. VR pattern detection every 1,000 copies using the ID sensor avoids this problem.



Every time VR pattern detection is done, a strip across the drum is charged using zero development bias and the standard charge on the drum charge roller that is used for copying (with all corrections included). At the same time, all the blocks of the erase lamp turn on to illuminate this charged area of the drum.

If there is residual voltage on the drum, this area of the drum will attract some toner, making a VR pattern. The ID sensor checks the reflectivity of the VR pattern. This sensor output voltage is VRP.

In VR detection, VRP is compared with VRG.

- VRG is the reflectivity of the bare area of the drum, measured by the ID sensor. It has the same value as VSG (see Image Density Control - VSG and VSP Detection).
- VRP is the output from the ID sensor reflected from the VR pattern.

When the drum residual voltage increases, the VR pattern becomes darker. Then, VRP decreases and the VRP/VRG ratio decreases.

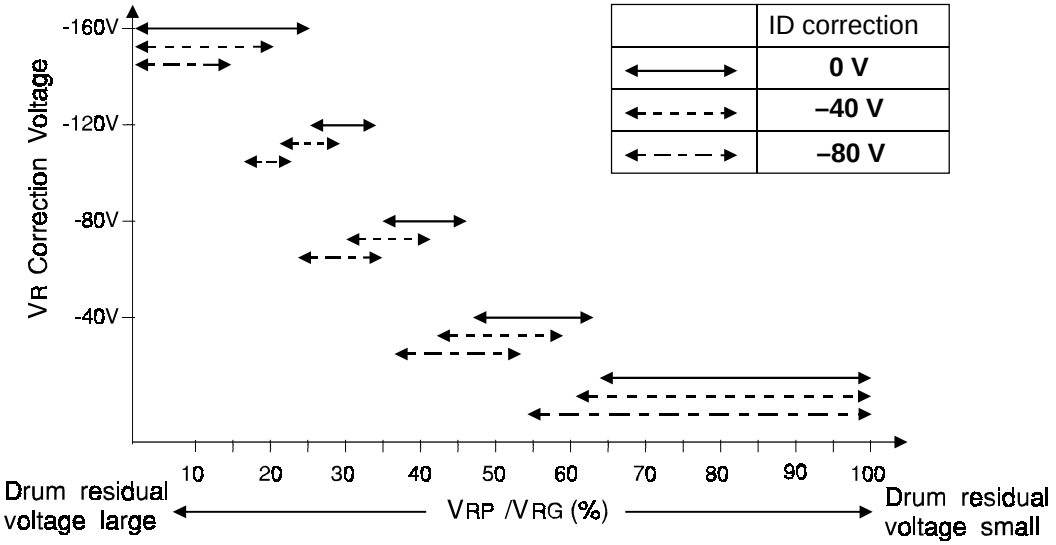
Then the CPU increases the negative development bias voltage to prevent dirty background, and simultaneously increases the negative drum charge roller bias voltage to prevent low image density. This is the VR correction.

Table 11. VR correction

	ID Correction			Drum Charge Roller Correction Voltage	Development Bias Correction Voltage
	±0 V	–40 V	–80 V		
VRP/VRG x 100(%)	64 ~ 100	60 ~ 100	54 ~ 100	±0 V	±0 V
	47 ~ 63	42 ~ 59	36 ~ 53	–40 V	–40 V
	35 ~ 46	30 ~ 41	24 ~ 35	–80 V	–80 V
	26 ~ 34	21 ~ 29	16 ~ 23	–120 V	–120 V
	0 ~ 25	0 ~ 20	0 ~ 15	–160 V	–160 V

For example, taking the ID correction to be zero for now, if VRP/VRG is 45%, the drum charge and development bias corrections will both be -80V.

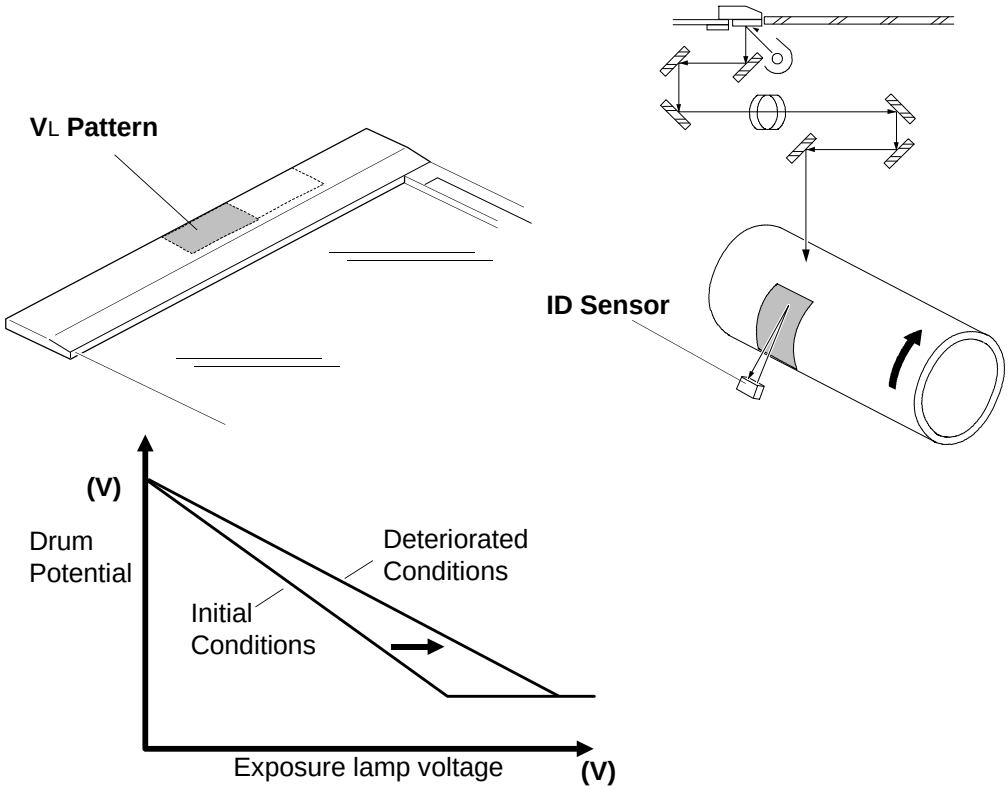
VR correction also depends on the current VSP pattern ID correction that is being used. If development bias has been increased by ID correction, the VR correction may be smaller in some cases to take this into account. This is shown by both the table above and the following figure.



Using the same example to illustrate this, but with an ID correction of -40V, the corrections will both be -40 V this time.

Note that forced V_R detection by SP mode must be done when a new drum is installed or the ID sensor cleaned or replaced. (See Service Tables - Practical SP Mode Use Tables for the correct sequence of SP modes to perform at this time). The correction is done in the same way as described above.

1.4.2 VL Pattern Correction



Dirty optics or deterioration of the exposure lamp decreases the intensity of the light that reaches the drum via the optics cavity. As more copies are made during the drum's life, the photoconductive layer gets worn and the response of the drum to the exposure lamp weakens.

VL pattern correction counteracts dirty background caused by the factors mentioned above.

The VL pattern is a light gray sensor pattern on the operator side of the bottom of the left scale bracket. The ID sensor output at VSG detection in memory is used again as VLG (the reflectivity of the bare area of the drum).

When VL pattern detection starts, the exposure lamp turns on and the main motor stays on to rotate the drum. The drum charge roller, all the blocks of the erase lamp, the pre-transfer lamp, and the quenching lamp turn on. Then, the appropriate blocks of the erase lamp turn off and on to make a VL pattern on the drum surface.

In VL detection, VLP is compared with VLG.

- VLG is the reflectivity of the bare area of the drum, measured by the ID sensor. It has the same value as VSG (see Image Density Control - VSG and VSP Detection).
- VLP is the output from the ID sensor reflected from the VL pattern.

V_L detection is done at the following times:

- Every 1000 Copies
- Forced Detection: whenever a new drum or exposure lamp is installed, or exposure lamp voltage is adjusted, or when the optics are cleaned, forced V_L detection (SP3-105) must be executed. (See Service Tables - Practical SP Mode Use Tables for the correct sequence of SP modes to perform at this time).

  Forced V_L detection is different from the routine 1,000 copy V_L detection, so it is explained below in detail.
  During forced V_L detection, BL and V_{REF} are determined as shown below.
  NOTE: BL = Development bias used for V_L correction.

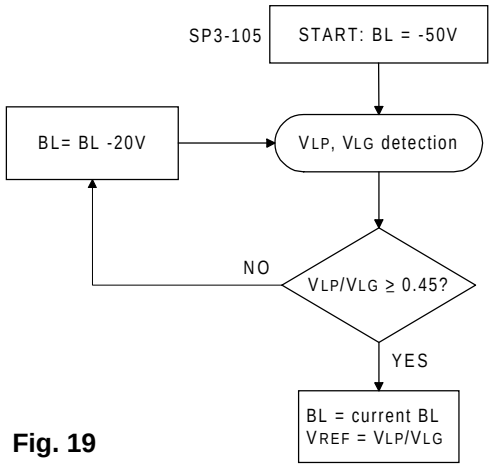


Fig. 19

BL starts at -50 V and -20 V is added until the value of V_{LP} is appropriate.

V_L Correction Method

During V_L pattern detection, lamp voltage, drum charge voltage and development bias are as follows.

- Lamp voltage: same as during normal copying (ADS mode)
- Drum charge voltage for the V_L pattern: same as during normal copying
- Development bias for forced V_L detection: BL + V_R correction + $V_{BL(ID)}$
- Development bias for V_L detection every 1000 copies:
  = BL + (–25 V) + V_R correction + $V_{BL(ID)}$

V_{BL} (ID) is an ID compensation factor based on the current ID correction used for the V_{SP} pattern (see Image Density Control for details on this ID Correction). It is applied as shown in Table 12.

Table 12

ID correction	0 V	–40 V	–80 V
V_{BL}(ID)	±0 V	–10 V	–20 V

- Forced V_L **Detection -**

When forced V_L detection (SP3-105) is executed, the CPU stores the V_L reference value (V_{REF}) in memory (see Fig. 19).

V_{REF} = initial V_{LP}/V_{LG}

- Every 1,000 copies -

After the forced V_L detection, V_L detection is performed at the end of every 1000 copies. The V_{LP}/V_{LG} value at that time is called V_{DAT}.

V_{DAT} = current V_{LP}/V_{LG}

- During Copying -

The CPU compares the latest V_{DAT} with the latest V_{REF} and applies a V_L correction to the exposure lamp voltage as shown below.

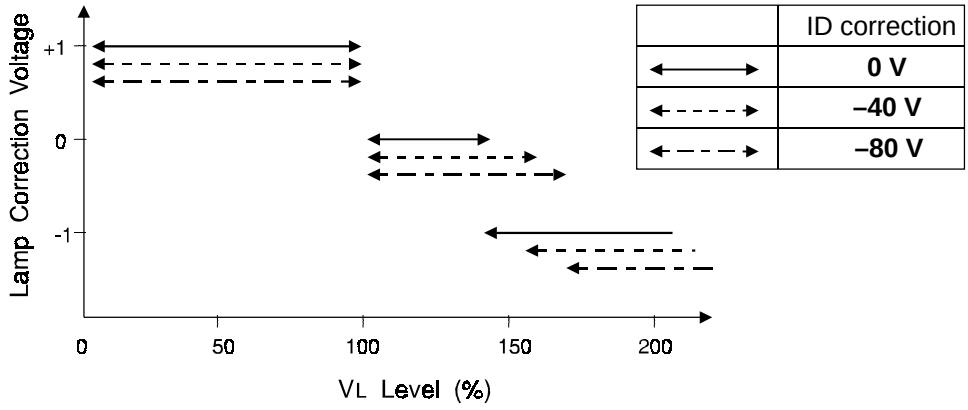
Table 13. V_L Correction

	ID Correction			Lamp Correction Voltage
	±0 V	–40 V	–80 V	
V_{DAT}/V_{REF} x 100 (%)	146 ~	156 ~	168 ~	–1 V
	101 ~ 145	101 ~ 155	101 ~ 167	±0 V
	~ 100	~ 100	~ 100	+1 V

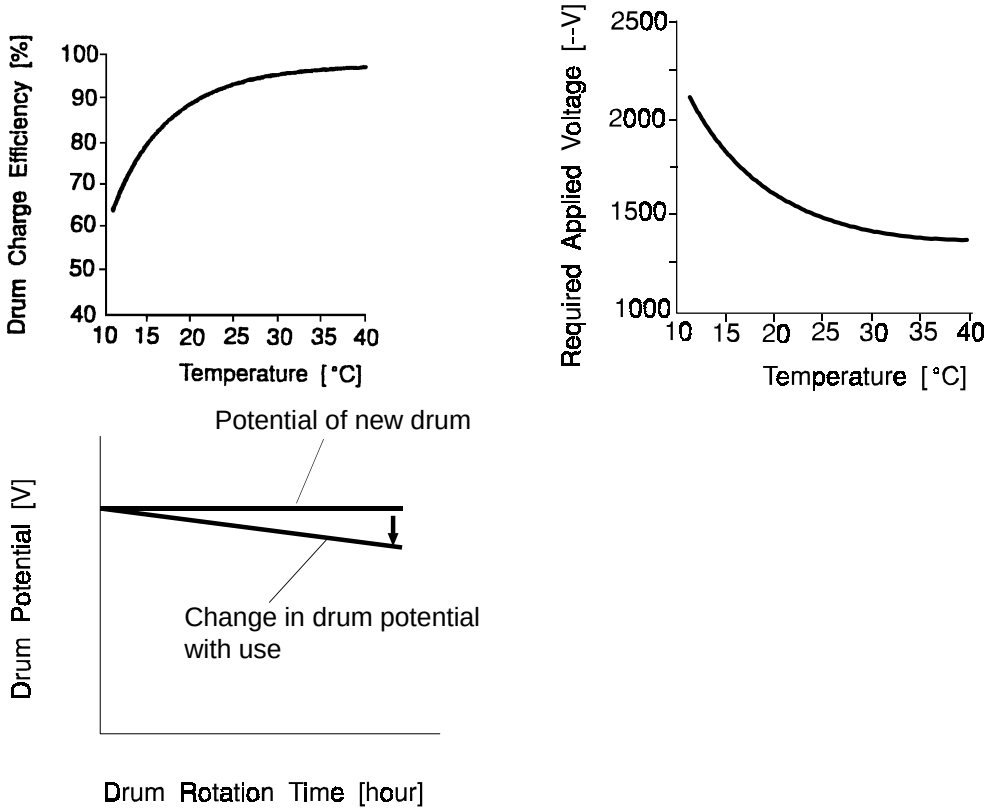
In general, the lamp will be dimmed slightly if the V_{LP} pattern reflectivity has increased significantly (the V_{LP} pattern is paler), and made brighter if the reflectivity has decreased (the V_{LP} pattern is darker).

V_L correction also depends on the current V_{SP} pattern ID correction that is being used (see Image Density Control - ID Correction for the V_{SP} pattern).

For example, taking the ID correction to be zero for now, if V_{DAT}/V_{REF} is 150%, the lamp correction will be -1V (made slightly dimmer). Using the same example, but with an ID correction of -40V, the correction will be 0 V this time.



1.4.3 T/H Correction



The drum charge efficiency is the ratio of the charge actually on the drum to the charge that was applied to the drum. It varies with the temperature around the drum charge roller. It drops off at lower temperatures, so the lower the temperature is, the higher the charge that is required.

Also, as the drum ages, the photoconductive layer gets worn. This causes a decrease in the drum potential after charging.

The drum charge thermistor detects the temperature (T) around the drum charge roller. The drum charge roller voltage is changed to account for the effects of temperature on drum charge efficiency.

The CPU also keeps track of the drum rotation time (H) that corresponds to the wear on the drum surface. The drum charge roller voltage is increased at set intervals.

These corrections for the drum charge roller voltage are called T/H correction.

The T/H correction that is applied during copying differs from that applied when making ID sensor patterns. See below for how the correction is determined.

The T/H correction difference between the A153, A155, and A156 copiers and the A157, A159, and A160 copiers is a result of the difference in copy processing speed (200 mm/s for the A153, A155, and A156 copiers, compared with 150 mm/s for the A157, A159, and A160 copiers).

Table 14. T/H Correction (Copying) - Base drum charge voltage = -1500 V

A153, A155, and A156 copiers

Drum Charge Roller Temperature (T)	Drum Rotation Time (H)		
	0 ≤ H < 40	**40 ≤ H < 110**	**110 ≤ H**
37.1 ≤ T	-60.0	-60.0	-60.0
29.6 ≤ T < 37.1	-203.4 + 3.9xT	-203.4 + 3.9xT	-203.4 + 3.9xT
17.9 ≤ T < 29.6	-729.1 + 21.6xT	-923.9 + 28.2xT	-1116.1 + 34.7xT
12.6 ≤ T < 17.9	-1345.1 + 56.0xT	-1705.8 + 71.9xT	-2068.9 + 87.9xT
T < 12.6	-639.0	-800.0	-961.0

A157, A159, and A160 copiers

Drum Charge Roller Temperature (T)	Drum Rotation Time (H)		
	0 ≤ H < 40	**40 ≤ H < 110**	**110 ≤ H**
32.4 ≤ T	-80.0	-80.0	-80.0
28.2 ≤ T < 32.4	-426.7 + 10.7xT	-426.7 + 10.7xT	-426.7 + 10.7xT
18.0 ≤ T < 28.2	-621.8 + 17.6xT	-768.4 + 22.8xT	-912.2 + 27.9xT
12.4 ≤ T < 18.0	-1028.6 + 40.2xT	-1357.2 + 55.5xT	-1689.7 + 71.1xT
T < 12.4	-530.0	-669.0	-808.0

Table 15. T/H Correction (V_{SP} Pattern) - Base drum charge = -1300 V

A153, A155, and A156 copiers

Drum Charge Roller Temperature (T)	Drum Rotation Time (H)		
	0 ≤ H < 40	**40 ≤ H < 110**	**110 ≤ H**
37.1 ≤ T	+40.0	+40.0	+40.0
29.6 ≤ T < 37.1	-103.4 + 3.9xT	-103.4 + 3.9xT	-103.4 + 3.9xT
17.9 ≤ T < 29.6	-489.9 + 16.9xT	-603.8 + 20.8xT	-717.6 + 24.6xT
12.6 ≤ T < 17.9	-862.5 + 37.7xT	-1164.2 + 52.1xT	-1465.9 + 66.4xT
T < 12.6	-387.0	-508.0	-629.0

A157, A159, and A160 copiers

Drum Charge Roller Temperature (T)	Drum Rotation Time (H)		
	0 ≤ H < 40	**40 ≤ H < 110**	**110 ≤ H**
32.4 ≤ T	+24.0	+24.0	+24.0
28.2 ≤ T < 32.4	-283.9 + 9.5xT	-283.9 + 9.5xT	-283.9 + 9.5xT
18.0 ≤ T < 28.2	-402.6 + 13.7xT	-532.4 + 18.3xT	-662.2 + 22.9xT
12.4 ≤ T < 18.0	-719.3 + 31.3xT	-919.5 + 39.8xT	-1117.6 + 48.2xT
T < 12.4	-331.0	-426.0	-520.0

For example, when copying with an A157 copier at 25°C with a drum that has a rotation time of 100 hours:

- The T/H correction is -768.4 + (22.8 x 25) V = -198.4 V.
- The drum charge roller voltage is the base voltage plus the T/H correction
  = (-1500) - 198.4
  = -1698.4 V.

1.5 PROCESS CONTROL DURING ABNORMAL CONDITIONS

When an abnormal sensor condition occurs, some process controls are disabled.

<table>
<tr><th rowspan="2">Abnormal Condition</th><th colspan="4">Process Control</th></tr>
<tr><th>ID Sensor Adjustment</th><th>V_R Correction</th><th>V_L Correction</th><th>ADS Sensor Adjustment</th></tr>
<tr><td>Thermistor Error</td><td colspan="4" rowspan="5">Disabled</td></tr>
<tr><td>TD Sensor Adjustment Error</td></tr>
<tr><td>TD Sensor Detection Error</td></tr>
<tr><td>V_{SP} Error</td></tr>
<tr><td>V_L Error</td></tr>
<tr><td>ID Sensor Adjustment Error</td><td rowspan="2">Executed</td><td colspan="3" rowspan="2">ID sensor adjustment error → Disabled
If the ID sensor can be adjusted → Executed</td></tr>
<tr><td>V_{SG} Error</td></tr>
</table>

1.6 SUMMARY

1.6.1 Process Control and Sensor Detection Timing

A summary of process control and correction timing is shown below.

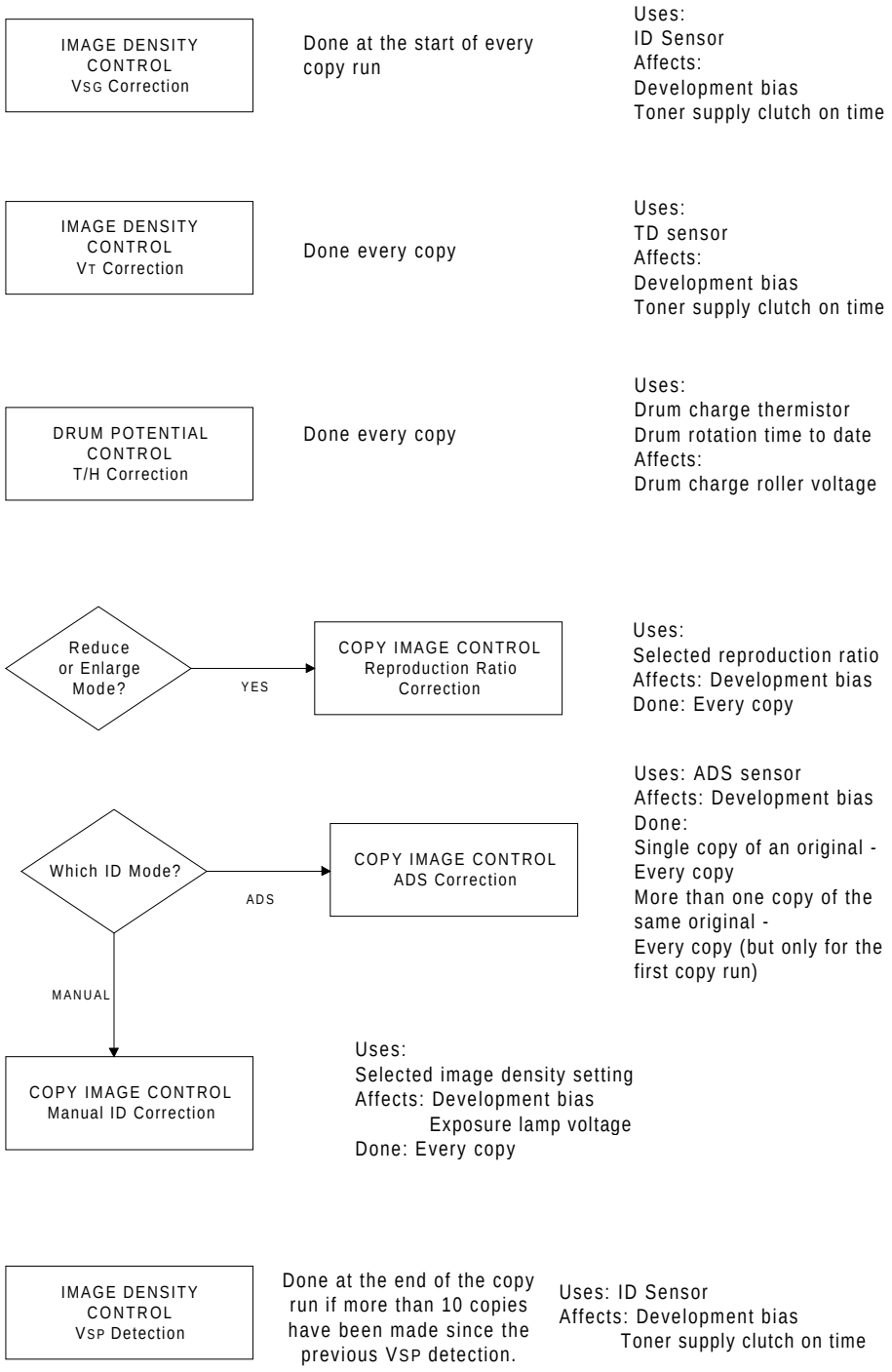
Correction	Electrical Component	Sensor Output Used	Correction Timing		Corrected Value
			Forced Correction	Automatic Correction	
Manual ID correction	Operation panel	—	—	Every copy in manual ID mode	• Lamp voltage • Dev. bias
Reproduction ratio correction	Operation panel	—	—	Every copy in reduce/enlarge mode	Development bias
ADS correction	ADS sensor	V_{ADS} (pattern) V_{ADS} (original)	—	• ADS Mode: Once per original (ARDF mode), or once when the Start key is pressed (Platen mode)	Development bias
			New drum, ADS sensor, or exposure lamp	Every 1000 copies	• V_{ADS} (pattern) is stored
ID correction and Toner density control	ID sensor	V_{SG}	New drum or ID sensor replacement	At the start of each copy job	• Dev. bias • Toner supply clutch ON time
		V_{SP}		About every 10 copies	
	TD sensor	V_T	When the developer is changed	Every copy	
V_R correction	ID sensor	V_{RP}, V_{RG}	New drum or ID sensor replacement	After every 1000 copies	• Drum charge roller voltage • Dev. bias
V_L correction	ID sensor	V_{LP}, V_{LG}	New drum or exp. lamp		Lamp voltage
T/H correction	• Drum charge roller thermistor • RAM Board	T: (temperature) H: (drum rotation time)	H is reset at the drum initial setting	Every copy	Drum charge roller voltage

1.6.2 Process Control Checks During Machine Operation

This section shows what the machine checks and recalibrates to control the copy process at different times.

Every Copy

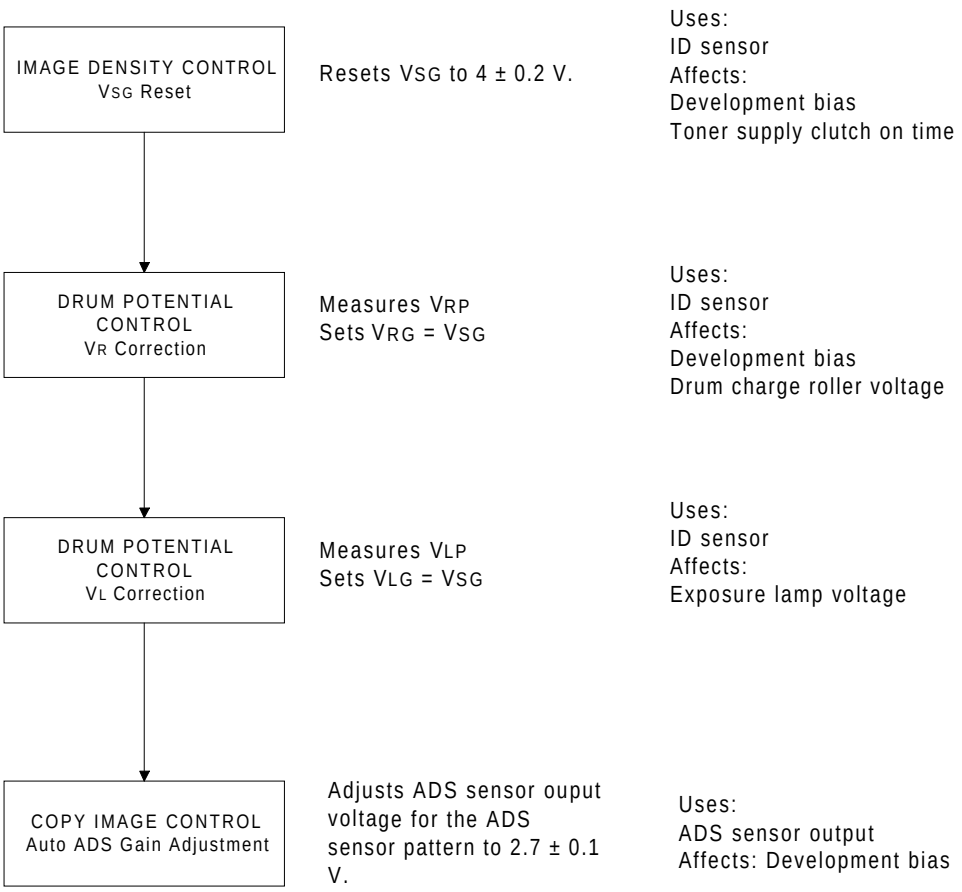
The machine automatically adjusts the following process control parameters every copy.



Every 1000 Copies

After every 1,000 copies, the machine calibrates the following reference values for the various processes that are used in process control.

NOTE: If the auto process control mode has been disabled with SP3-801, this process control cycle will not be performed.



After Adding New Developer

The technician must do the following SP mode after adding new developer.

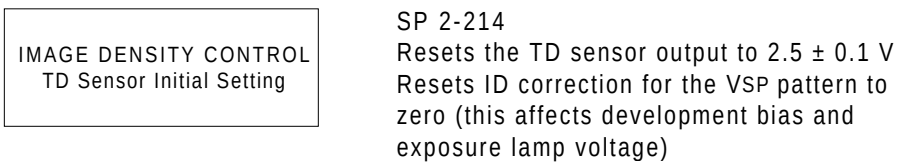
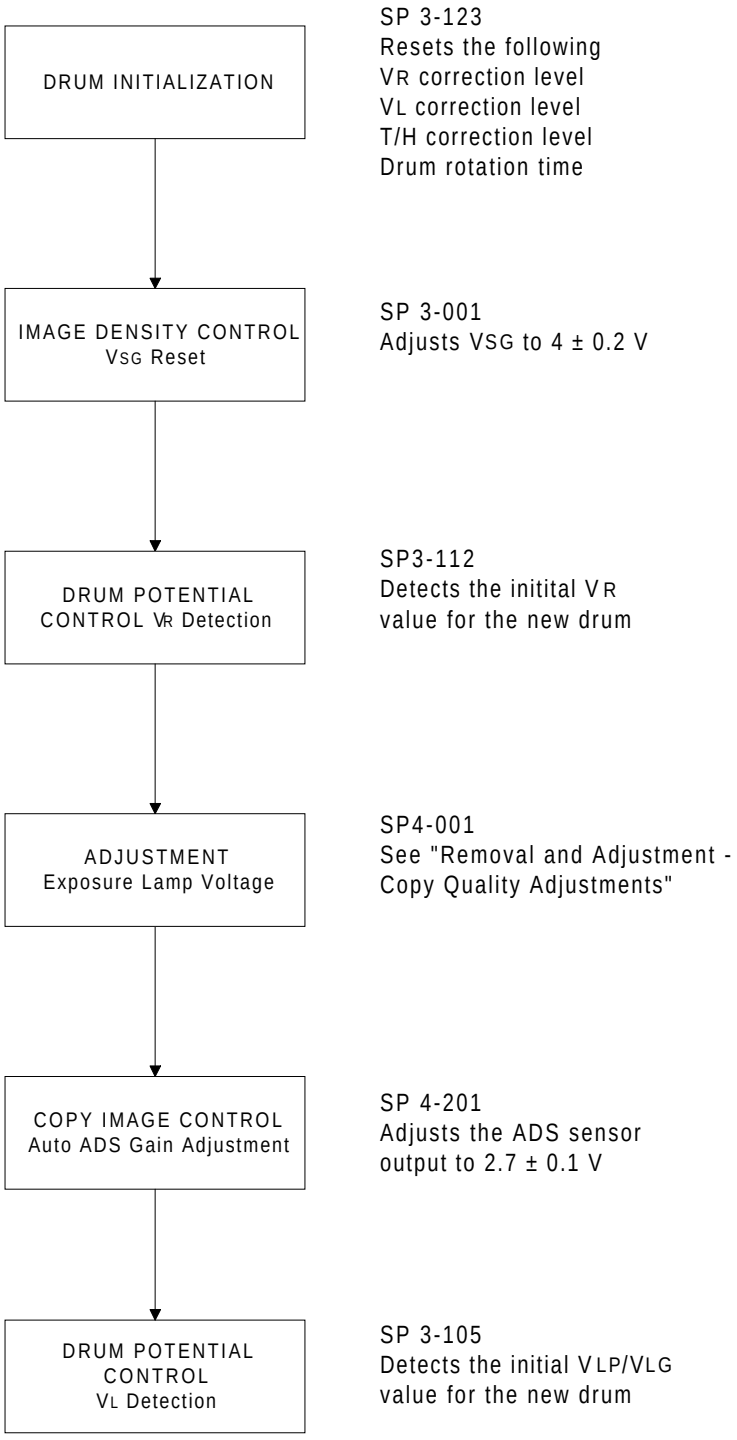


IMAGE DENSITY CONTROL
TD Sensor Initial Setting
SP 2-214
Resets the TD sensor output to 2.5 ± 0.1 V
Resets ID correction for the VSP pattern to zero (this affects development bias and exposure lamp voltage)

After Installing a New Drum

The technician must do a series of SP modes to reset the process control parameters related to the drum.



Development bias, drum charge voltage, and exposure lamp voltage

The following table shows how process control affects development bias, drum charge, and exposure lamp voltages for various machine operations.

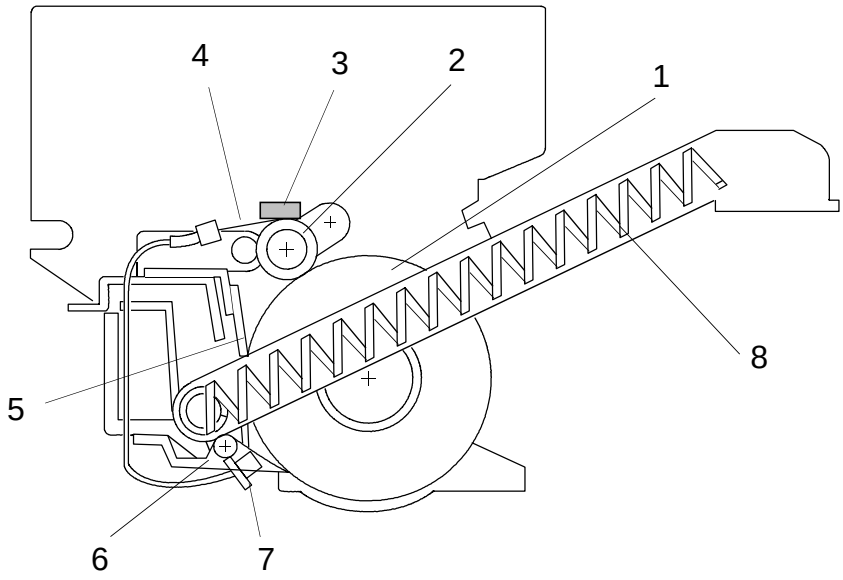
Mode			Development Bias [V]	Drum Charge Voltage [V]	Exposure Lamp Voltage [V]
Copying	ADS mode		(–240) + ADS correction + Reproduction ratio correction + V_R correction + B	(–1500) + V_R correction + T/H correction + C	Vexp + V_L correction
	Manual ID mode	ID Level 1 ~ 6	(–240) + Manual ID correction + Reproduction ratio correction + V_R correction + B		Vexp + Manual ID correction + V_L correction
		ID Level 7	(–240) + Lightest ID level dev.bias + Reproduction ratio correction + V_R correction + B		
VSP Pattern Detection			(–300) + BP + ID correction	(–1300) + T/H correction + CP	0
VR Pattern Detection			0	(–1500) + V_R correction + T/H correction + C	0
V_L Pattern Detection	Forced V_L Detection		BL + V_R correction + V_{BL} (ID)		Vexp
	V_L Detection		BL + (–25) + V_R correction + V_{BL} (ID)		Vexp + V_L correction
Non Image Area			(–200) + V_R correction + V_{BL} (ID)	0	0
Auto ADS Gain Adjustment			0	0	Vexp + V_L correction

NOTE:

B = Development bias adjustment factor, selected with SP2-201-001.
BP = Correction to the development bias used for making for V_{SP} patterns, selected with SP2-203.
BL = The value of the development bias that was reached during the most recently performed forced V_L detection routine.
V_{BL} (ID) = ID compensation factor based on the current ID correction used for making V_{SP} patterns.
C = Correction to the drum charge voltage, selected with SP2-001.
CP = Correction to the drum charge voltage for maknig V_{SP} patterns, selected with SP2-003.
Vexp = Exposure lamp voltage, selected with SP4-001.

2. DRUM

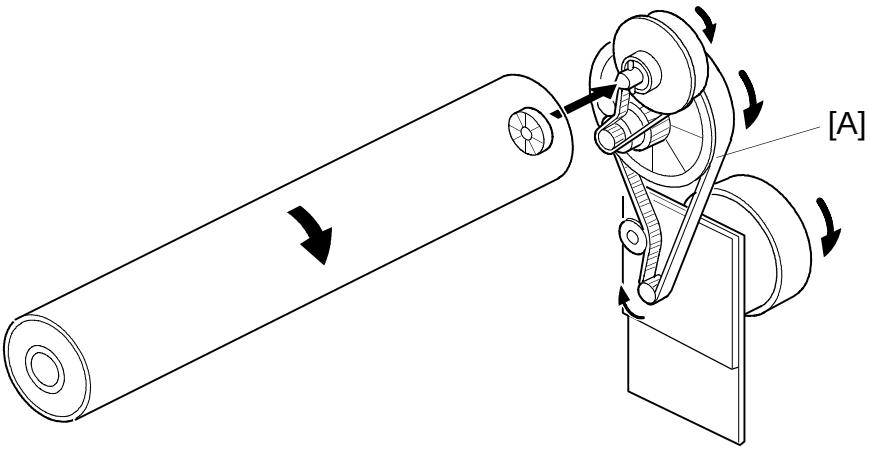
2.1 DRUM UNIT

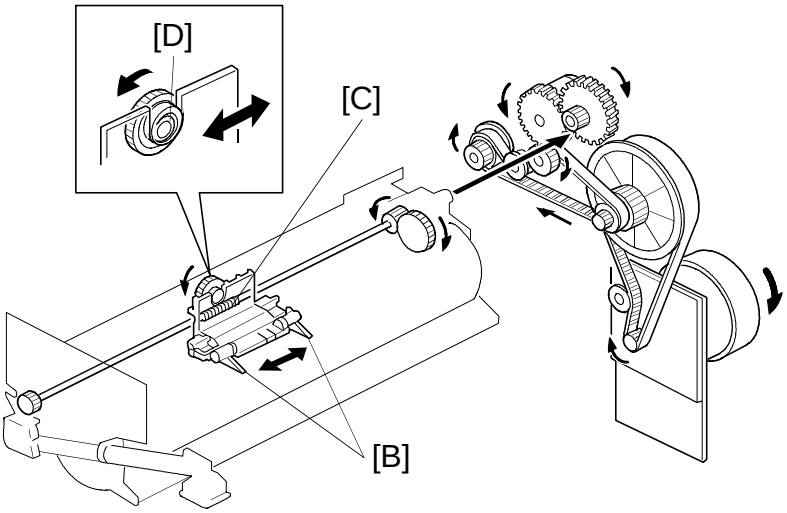


The drum unit consists of the components shown in the above illustration. An organic photoconductor (OPC) drum (diameter: 60 mm) is used for this model.

1. OPC Drum
2. Drum Charge Roller
3. Drum Charge Roller Cleaner
4. Drum Charge Thermistor
5. Cleaning Blade
6. Pick-off Pawl
7. ID Sensor
8. Recycled Toner Transport Coil

2.2 DRIVE MECHANISM

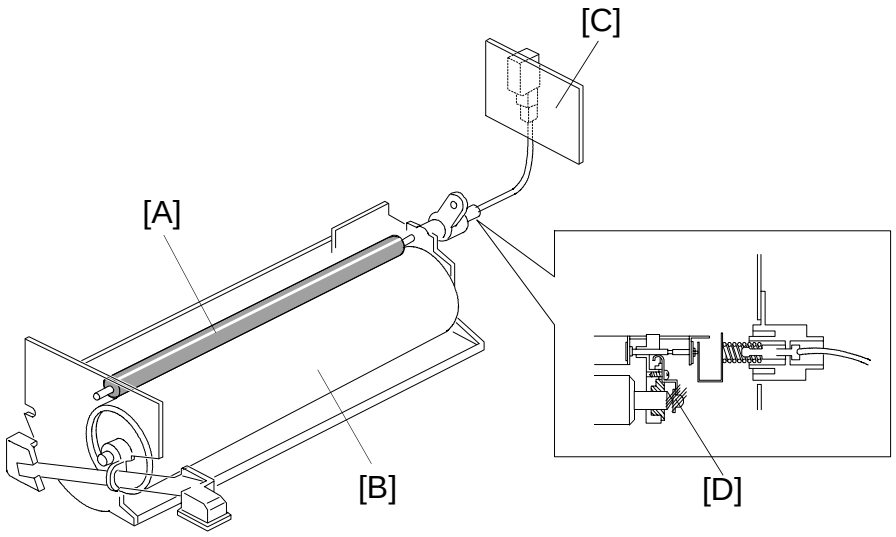




The drive from the main motor is transmitted to the drum drive pulley via the timing belt [A]. The pick-off pawls [B] are always in contact with the drum surface under a light spring pressure. They move from side to side during the copy cycle. This movement is made with a worm gear [C] and an eccentric cam gear [D].

3. DRUM CHARGE

3.1 OVERVIEW



This copier uses a drum charge roller system instead of a corona wire scorotron system to charge the drum. For the copy image area or during process control, the drum charge roller [A] contacts the surface of the OPC drum [B] to give a sufficient negative charge.

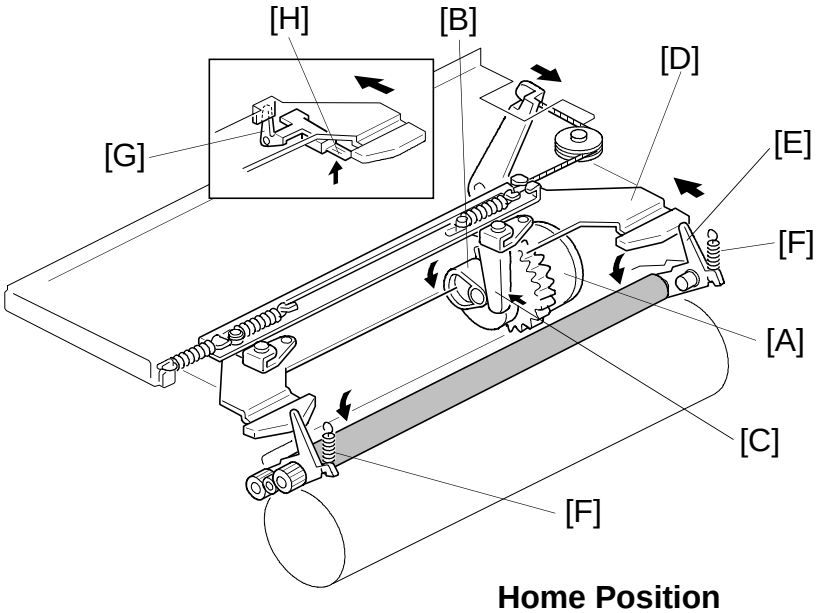
The drum charge roller system has the following advantages over the corona wire scorotron system:

- The amount of ozone generated during drum charging is less than 1/10 of that for a corona wire scorotron system.
- The applied voltage is 1/2 ~1/3 that of a wire scorotron system.
- The efficiency of drum charging is high.

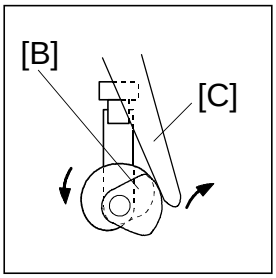
Thanks to the above advantages, no ozone filter is required for this copier.

The CB high voltage supply board [C] gives a constant dc voltage of –1500 V (–1300 V for the VSP pattern) to the drum charge roller at the charge roller terminal [D]. This gives the drum surface a negative charge of –900 V (–600 V for the VSP pattern).

3.2 DRUM CHARGE ROLLER DRIVE MECHANISM

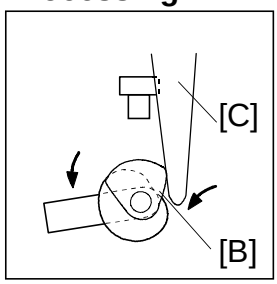


Home Position



The drum charge roller is away from drum

During Image Processing

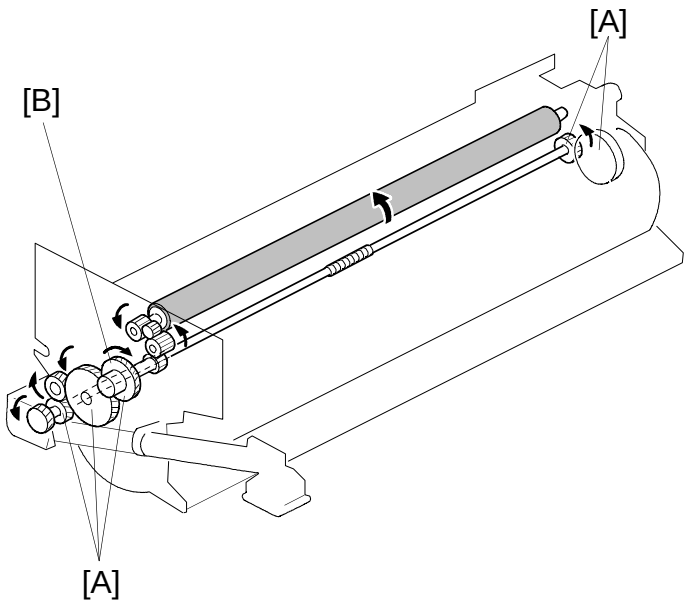


The drum charge roller contacts the drum

To prevent toner from adhering to the drum charge roller and to prevent the drum charge roller from sticking to the OPC drum, the drum charge roller contacts the OPC drum only under the following conditions:

(1) When the image processing area comes under the drum charge roller
(2) When process control is executed.

This function is performed by the transfer belt contact clutch [A] (a one-third turn clutch) and cam [B] located on the rear side plate of the copier. When the clutch [A] is driven one third of a complete rotation, the cam [B] drives lever [C] upward. The lever is linked with the plate [D] which releases the on-off lever [E] of the drum charge roller. Then the drum charge roller contacts the drum as a result of the pressure from the two springs [F]. At the same time, plate [D] also pushes the lever [G] on the drum charge thermistor [H]. Then, the drum charge thermistor moves away from the drum charge roller. When the start key is pressed, the temperature around the drum charge roller is measured while the drum charge thermistor contacts the drum charge roller. After that, the temperature is measured while the drum charge thermistor is away from the drum charge roller.



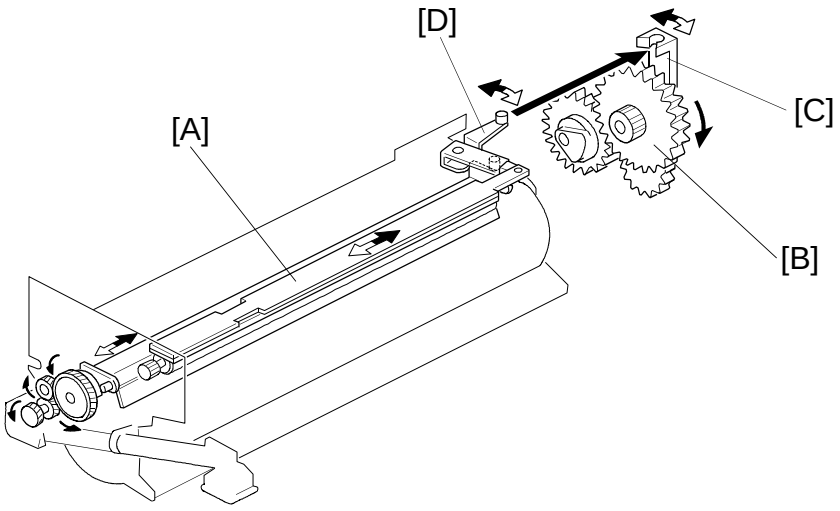
When the drum charge roller does not contact the drum, the drum charge roller is driven by the main motor through gears [A]. (The roller speed is 50 rpm for A153, A155, and A156 copiers, and 37 rpm for A157, A159, and A160 copiers.) At this time, the roller touches the cleaning pad, and this helps keep the roller clean, although a cleaning routine automatically takes place at the end of every copy cycle (see below).

When the drum charge roller contacts the drum, the force (torque) imparted by the drum becomes greater than the force transmitted through the clutch [B]. Then, the drum charge roller rotates with the drum.

The drum charge roller comes away from the drum after every copy job. For 2 seconds after the end of every copy job and for 10 seconds after every copy interval set by SP2-901, the drum charge roller is driven by the main motor via gears [A] for cleaning (see "Drum Charge Roller Cleaning").

After cleaning, the main motor stops. While the main motor is not rotating, the drum charge roller is kept away from the drum. This prevents the drum charge roller from adhering to the drum.

3.3 DRUM CHARGE ROLLER CLEANING



If the drum charge roller gets dirty, drum charge efficiency decreases. This affects the copy quality, for example causing vertical white lines.

While the drum charge roller is away from the drum but still rotating, it brushes against the cleaning pad [A], which helps to keep it clean.

However, there is a specific drum charge roller cleaning routine which is described below. It is executed at the following intervals:

(1) For 2 seconds at the end of every job
(2) For 10 seconds after the copy job interval set by SP2-901.

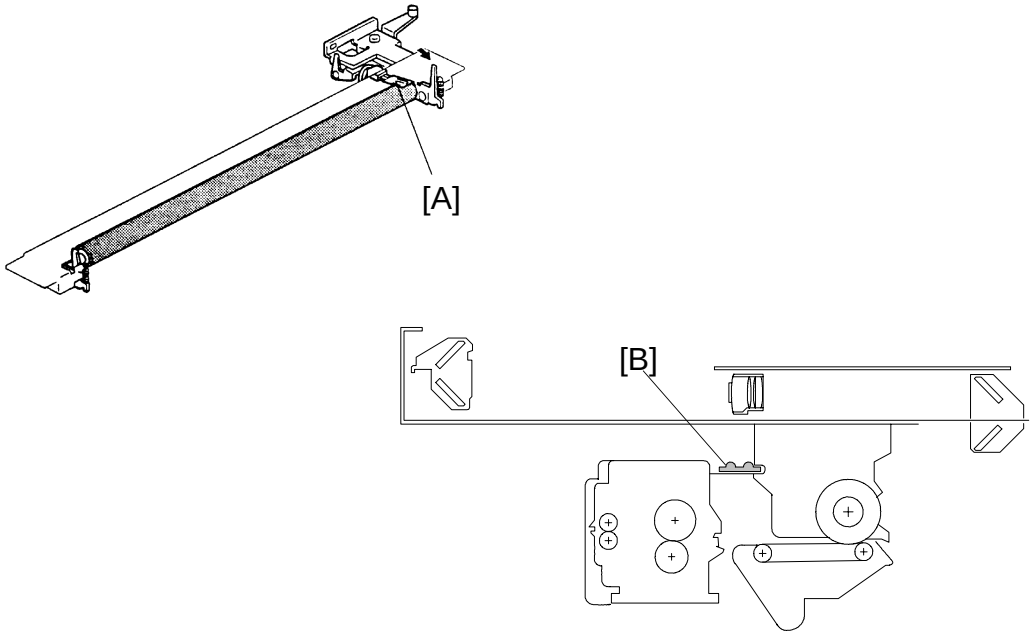
After the copy job, the drum charge roller comes away from the drum and contacts the drum charge roller cleaning pad [A]. The main motor still rotates during cleaning and drives the gear [B] to swing the lever [C] via an eccentric cam. This lever swings the arm [D] and the arm gives a side-to-side movement to the drum charge roller cleaner.

The cleaning interval set by SP2-901 is as follows:

SP2-901 setting: 0: Every 1000 copies (10 seconds) [default]
1: Every 500 copies (10 seconds)
2: Every 200 copies (10 seconds)
3: Every 100 copies (10 seconds)

For a user who mainly makes consecutive high volume copy runs, the drum charge roller is likely to get dirty early, because the interval between jobs (and thus the interval between end-of-copy-job cleaning runs) is longer than for small volume intermittent copy runs. In this case, the copy count interval for cleaning must be reduced with SP2-901, to have the ten-second cleaning routine done more often.

3.4 TEMPERATURE COMPENSATION



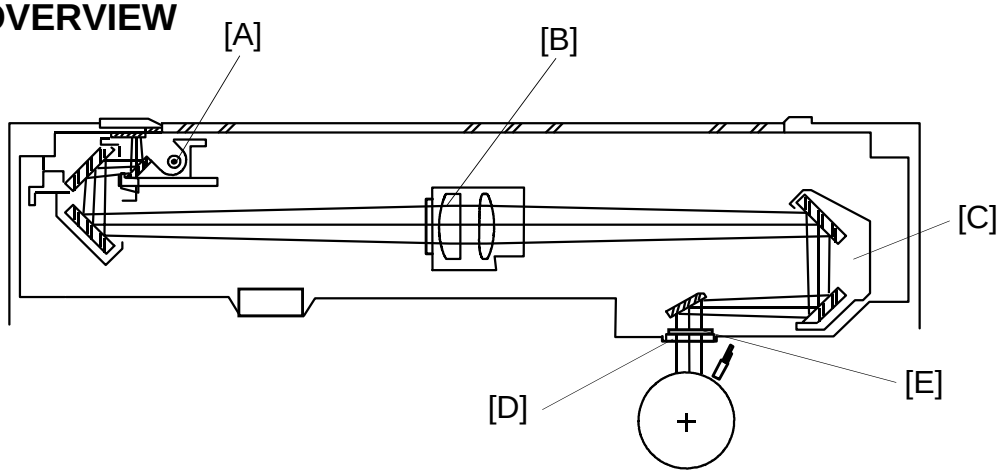
The applied voltage varies with the temperature around the drum charge roller. The lower the temperature is, the higher the applied voltage required. This affects the drum charge efficiency.

To compensate for these characteristics, the drum charge thermistor [A] detects the temperature around the drum charge roller. Before the copy job starts, the drum charge thermistor contacts the drum charge roller, T/H correction for the first copy uses the temperature detected while the drum charge thermistor contacts the drum charge roller. After the copy job starts, the thermistor is away from the drum charge roller. After the 2nd copy, T/H correction uses the temperature detected while the drum charge thermistor is away from the drum charge roller. Using the detected temperature, T/H correction is performed. (See "T/H correction" in the Process Control section for details.)

To avoid low drum charge efficiency for the first copy after the main switch is turned on, there is a drum heater [B] located over the drum and drum charge roller. This heater is turned on while the copier main switch is turned off. It keeps the temperature around the drum and drum charge roller over 15°C. For this heater to operate, the power cord of the copier must be plugged in even when the main switch is turned off.

4. OPTICS

4.1 OVERVIEW

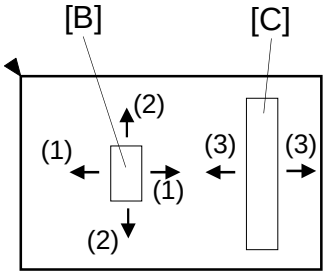


The optics unit reflects an image of the original on the exposure glass onto the OPC drum. This forms a latent electrical image of the original.

In this model, a halogen lamp is used for the exposure lamp [A]. The lamp surface is frosted to ensure even exposure. The specifications of the lamp are as follows. Note that the A153/155/156 models are faster, so they need more light during exposure.

	115V Machines	230V Machines
A153/A155/A156	97V 280W	85V 280W
A157/A159/A160	97V 200W	85V 200W

Six mirrors are used to make the optics unit smaller and obtain a wide reproduction ratio range (50 ~ 200%).



The lens [B] is driven by two stepper motors for (1) vertical movement (parallel to the paper feed direction) and (2) horizontal movement. Also, to correct for focal length change in reduction and enlargement modes, the third scanner unit [C] (4th and 5th mirrors) is moved (3) vertically (parallel to the paper feed direction) by another stepper motor.

A toner shield glass [D] and a green filter [E] are installed above the OPC drum to improve reproduction of red images or text.

The CPU monitors the temperature around the optics cavity through a thermistor which is under the left scale. When the detected temperature reaches a certain threshold value (see the following table), the optics cooling fan(s) on the rear of the optics side plate starts to draw cool air into the optics cavity. The hot air exits through the vents in the upper cover. The fan(s) operate until the temperature drops below the threshold temperature. Note that the A153/155/156 models have two fans; this is because the exposure lamp is more powerful in this model, so more cooling is needed.

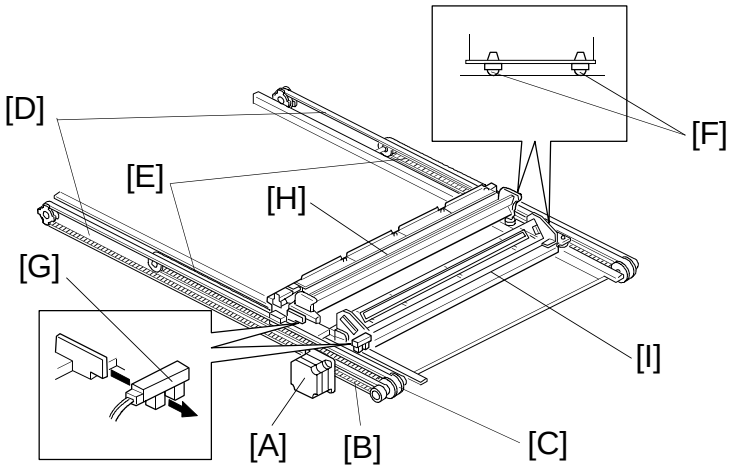
	A153/A155/A156	A157/A159/A160
Rotating temperature	45°C	40°C
Number of fans	2	1

The thermofuse (located on the 1st scanner) provides back-up overheat protection. It opens at 121°C and removes ac power to the exposure lamp. The thermofuse is not resettable.

An optics anti-condensation heater is available as optional equipment (it is also a service part). To prevent moisture from forming on the optics, it turns on while the main switch is turned off.

The main board controls the exposure lamp voltage through the ac drive board. The exposure lamp voltage is based on the base lamp voltage (set by SP4-001) and various correction factors. The corrections depend on whether the image density is manually selected or whether ADS mode is selected. For details, see Process Control - Summary.

4.2 SCANNER DRIVE



In this model, a stepper motor [A] drives the scanners via a timing belt [B], scanner drive pulley [C], and two long & short scanner drive belts [D,E]. To prevent skewing, both ends of each scanner are driven. The scanners have sliders [F], which ride on guide rails.

Unlike previous models, the scanner drive pulleys are made of aluminum. Also, bearings at the ends of the scanner drive pulley shaft assure reliable scanner speed and movement. The timing belt tension has increased as well.

The scanner home position is detected by the home position sensor [G]. The main CPU sends the appropriate pulses to the scanner drive motor (determined from the detected original size) to determine the scanner return position.

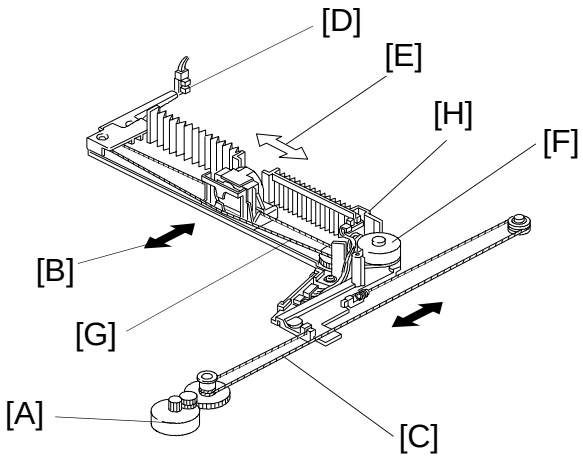
The first scanner [H], which consists of the exposure lamp and the first mirror, is connected to the two long scanner drive belts with belt clamps. The second scanner [I], which consists of the second and third mirrors, is connected to the two short scanner drive belts with belt clamps.

The first scanner drive speed in full size mode is:
200 (mm/s) for A153/A155/A156 copiers
150 (mm/s) for A157/A159/A160 copiers
The first scanner drive speed for a selected reproduction ratio is:
200/M (mm/s) for A153/A155/A156 copiers
150/M (mm/s) for A157/A159/A160 copiers

NOTE: M = Selected reproduction ratio (0.5 - 2.0)

The second scanner moves at half the velocity, and the returning speed of the first scanner is 1150 (mm/s) for all models.

4.3 LENS DRIVE



– Vertical (Parallel to the Paper Feed Direction) –

The lens vertical drive motor [A] changes the vertical position [B] of the lens in accordance with the selected reproduction ratio (50 ~ 200%). The motor, which is a stepper motor, drives the lens through the lens drive wire [C].

The lens vertical home position sensor [D] detects the vertical position of the lens for full size mode. The vertical position of the lens for the selected reproduction ratio is determined by the number of pulses from the full size position.

– Horizontal (Perpendicular to the Paper Feed Direction) –

The original's horizontal position on the exposure glass varies depending on the mode (platen or ADF). This prevents problems such as skewing that are caused when the original moves too close to the rear scale in automatic feed mode. However, the center is the standard position for copy paper feed.

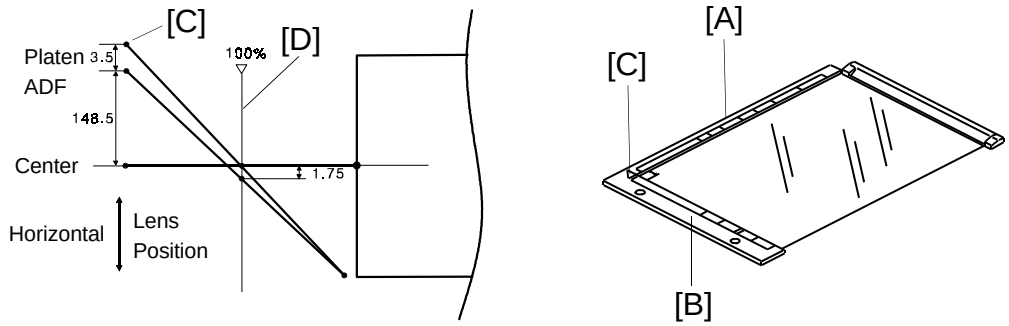
Therefore, the horizontal position [E] of the lens has to be changed in accordance with paper size, reproduction ratio, and original feed mode.

The lens horizontal drive motor [F] drives the lens through the lens drive wire [G]. The lens horizontal home position sensor [H] detects the horizontal position of the lens. The home position of the lens is the horizontal position for A4/LT sideways in full size and platen mode; the positions for other conditions are determined by counting the number of motor drive pulses from the home position.

Since this model has a horizontal lens drive mechanism, side-to-side registration adjustment for each feed station can be done easily using SP mode (SP4-011).

4.4 HORIZONTAL LENS POSITIONING

4.4.1 Original Alignment Position



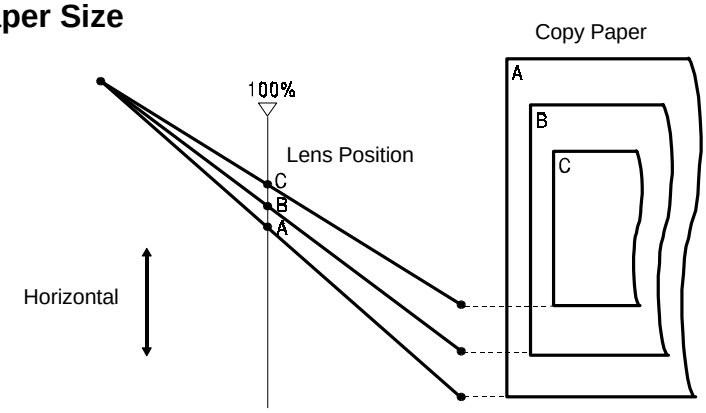
There are two standard original alignment positions: one for platen mode and one for ADF mode.

In platen mode, the original is aligned with both the rear [A] and the left [B] original scales (the rear left corner [C] is the standard alignment position).

In ADF mode, the original alignment position is 3.5 mm to the front of the platen mode original alignment position. This is to maintain the original transport path (which is at 3.5 mm from the rear scale).

On line [D] in the above diagram, you can see the horizontal positions of the lens for each original mode, with identical sizes of paper.

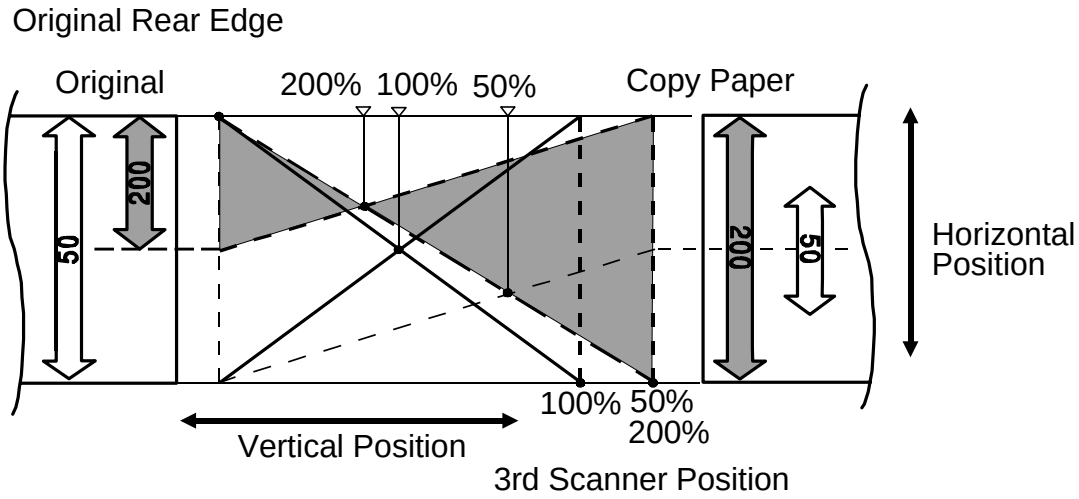
4.4.2 Paper Size



To maintain a high paper feed performance, the center line of the exposure glass is assigned to be the standard paper feed position. However, as described above, the original alignment position for original feed is not in the center of the exposure glass in this model. Therefore, the lens horizontal position has to be changed in accordance with the paper size.

The diagram shows the horizontal position of the lens for three paper sizes (A, B, and C) in full size mode.

4.4.3 Reproduction Ratio

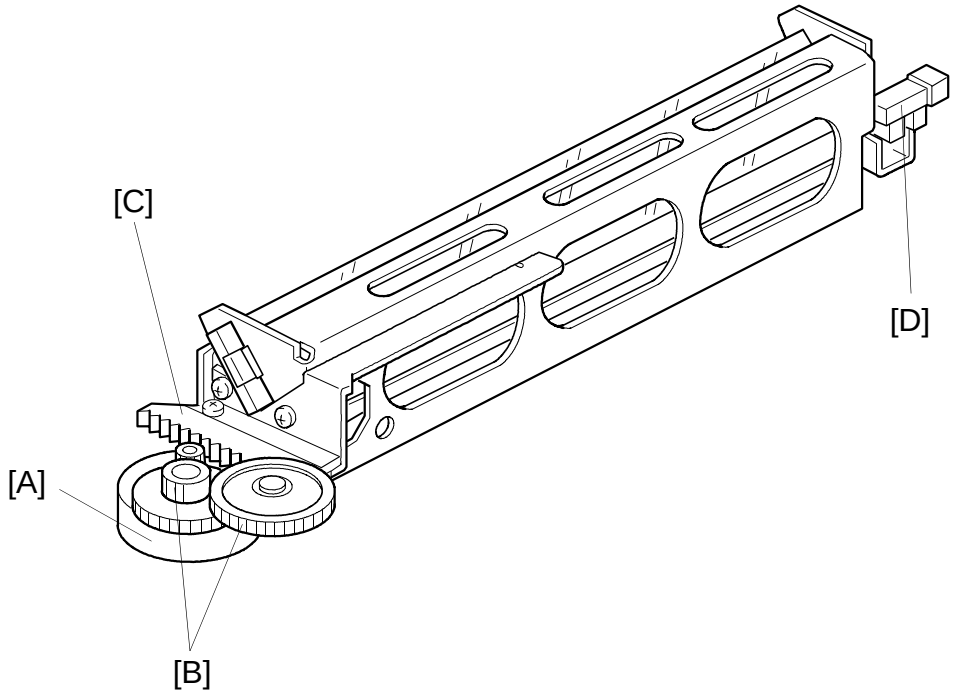


The horizontal position of the lens has to be changed when a reproduction ratio is selected. This is because the original is aligned at the rear left corner but the copy paper is fed down the center.

When the reproduction ratio is changed, the vertical position of the lens is changed. At the same time, the total focal length has to be changed to adjust the image focusing. For this focal length change, the vertical position of the 3rd scanner is also adjusted.

The figure shows the vertical and horizontal position of the lens for ratios of 50, 100 and 200%.

4.5 3RD SCANNER DRIVE

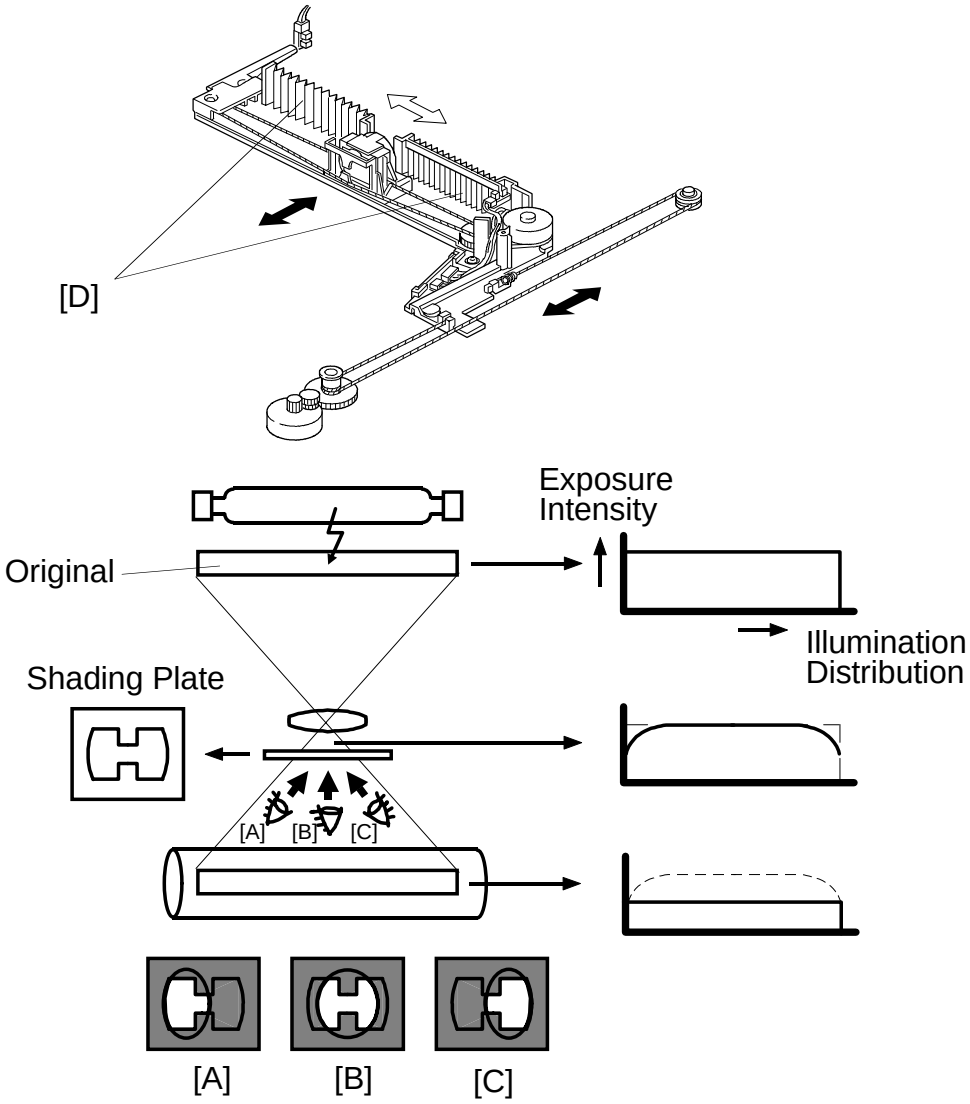


To compensate the focusing for reproduction and lens position changes, the 3rd scanner (4th and 5th mirrors) position is changed.

The 3rd scanner drive motor [A] (a stepper motor) changes the 3rd scanner position through the pinion gears [B] and the rack gear [C].

The 3rd scanner home position sensor [D] detects the 3rd scanner position for full size mode. The machine keeps track of the 3rd scanner position based on the number of motor drive pulses.

4.6 UNEVEN LIGHT INTENSITY CORRECTION

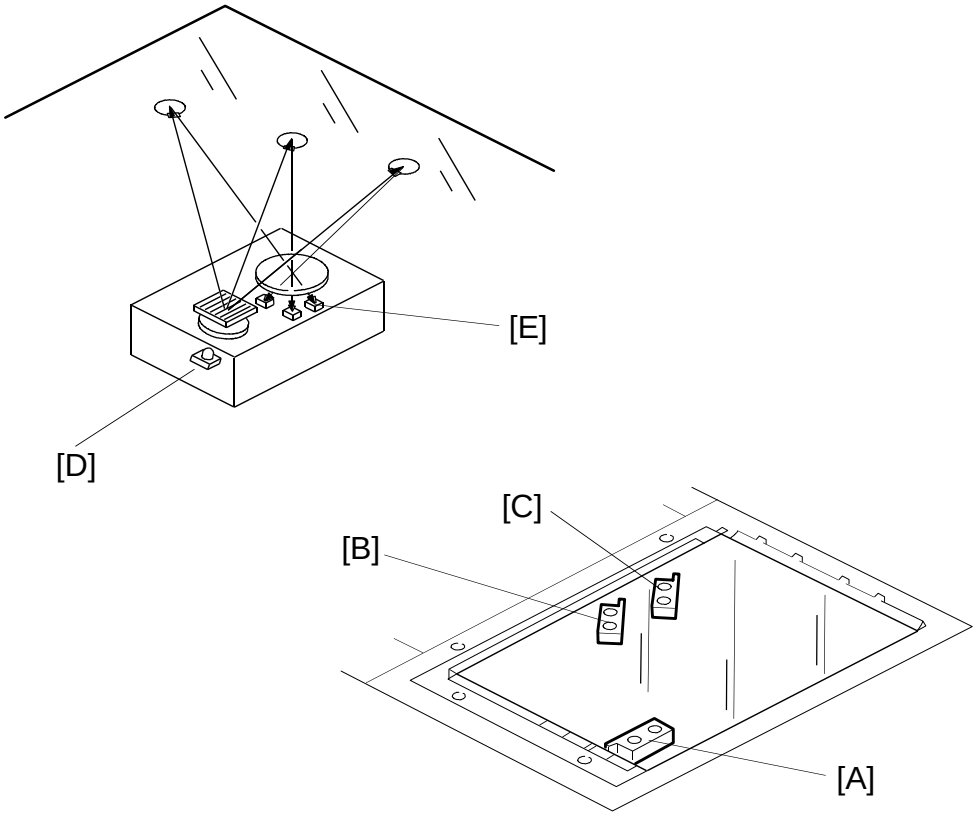


The entire exposure lamp surface is frosted to ensure even exposure.

To compensate for reduced light at the edge of the lens, a shading plate is placed in front of the lens. The shading plate is fixed to the lens unit. The shading plate corrects the light intensity when the lens horizontal position is shifted (from [A] to [C]).

Also, two shading mylars [D] intercept any stray reflected light from outside the light path.

4.7 ORIGINAL SIZE DETECTION IN PLATEN MODE

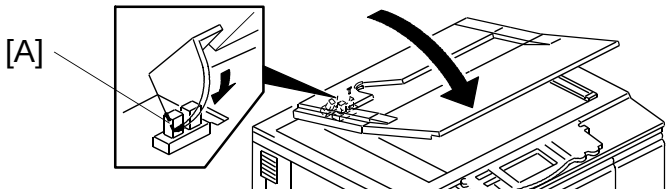


There are three reflective sensors in the optics cavity for original size detection. The Original Width Sensor [A] detects the original width and the Original Length Sensor-1 [B] and Original Length Sensor-2 [C] detects the original length. These are the APS (Auto Paper Select) sensors.

For North American models, there is an optional length sensor for detecting 11" x 15" originals.

Inside each APS sensor, there is an LED [D] and either three photoelectric devices [E] (for the width sensor) or one photoelectric device (for each length sensor). In the width sensor, the light generated by the LED is broken up into three beams and each beam scans a different point of the exposure glass (in each length sensor, there is only one beam). If the original or platen cover is present over the scanning point, the beam is reflected and each reflected beam exposes a photoelectric device and activates it.

While the main switch is on, these sensors are active and the original size data is always sent to the main CPU. However, the main CPU checks the data only when the platen cover is opened.



Original Size		Length Sensor			Width Sensor		
A4/A3 version	**LT/DLT version**	1	2	Op	3	4	5
A3	11" x 17"	O	O	O	O	O	O
—	(11" x 15")	O	O	X	O	O	O
B4	10" x 14"	O	O	O	O	O	X
F4	8 1/2" x 14"	O	O	O	O	X	X
F	8" X 13"	O	O	O	O	X	X
A4–L	8 1/2" x 11"	X	O	O	O	X	X
B5–L	—	X	O	O	X	X	X
A5–L	5 1/2" x 8 1/2"	X	X	O	X	X	X
A4–S	11" x 8 1/2"	X	X	O	O	O	O
B5–S	—	X	X	O	O	O	X
A5–S	8 1/2" x 5 1/2"	X	X	O	O	X	X

Note: –L= Lengthwise, –S = Sideways, O = High (Paper Present), X = Low

The original size data is taken by the main CPU when the platen position sensor [A] is activated. This is when the platen is positioned about 15 cm above the exposure glass. At this time, only the sensor(s) located underneath the original receive the reflected light and switch on. The other sensor(s) are off. The main CPU can recognize the original size from the on/off signals from the five sensors.

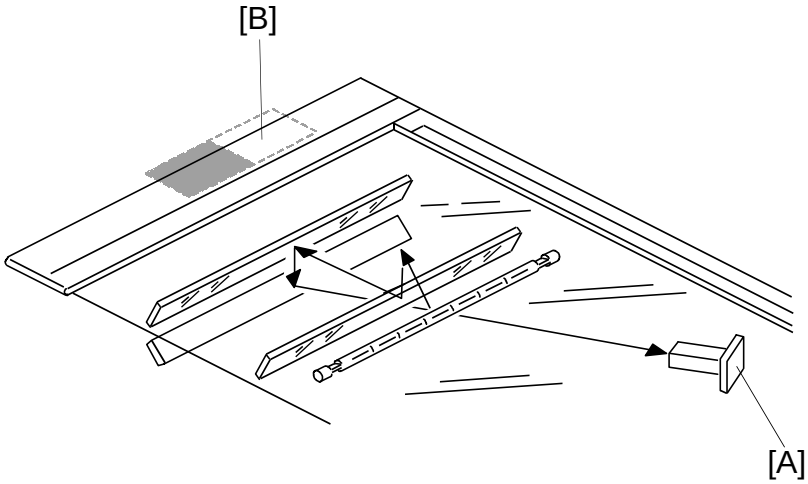
If the copy is made with the platen open, the main CPU decides the original size only from the sensor outputs when the Print key is pressed.

The above table shows the outputs of the sensors for each original size. The third length sensor (shown as "Op") is the optional length sensor for detecting 11" x 15" originals in North American models. (See FSM page 3-23)

This original size detection method eliminates the necessity for a pre-scan and increases the machine’s productivity.

Original size detection using the ARDF is described in the manual for the ARDF.

4.8 AUTOMATIC IMAGE DENSITY CONTROL SYSTEM (ADS)



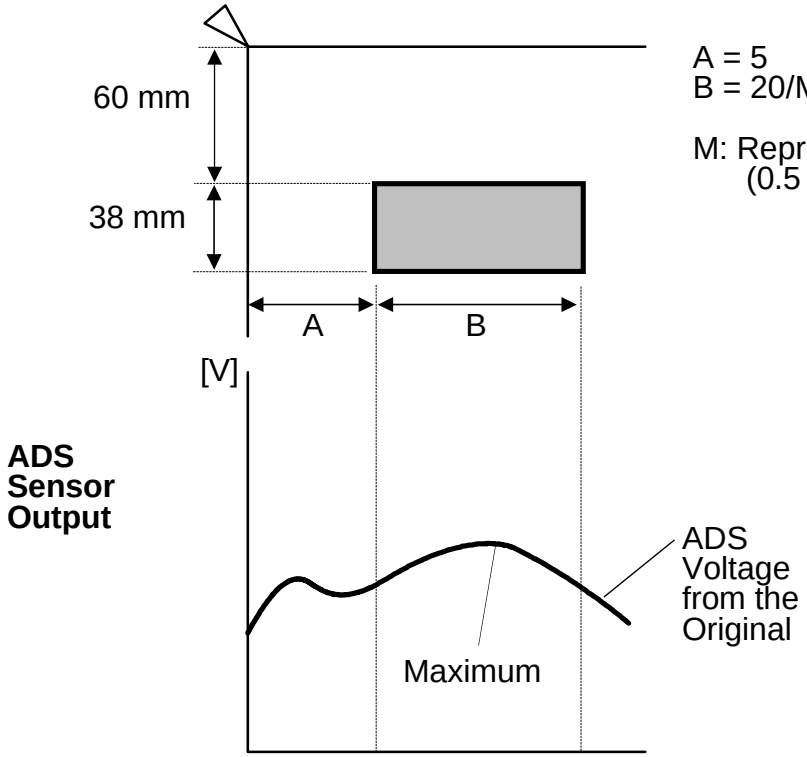
Just before taking a copy in ADS (Auto Image Density Select) mode, the ADS sensor [A] measures the original background density and the main CPU changes the development bias for the original to prevent dirty background from appearing on the copy. The exposure lamp voltage is fixed at the manual ID level 4 value (set by SP4-001) regardless of the input from the ADS sensor.

The ADS sensor board is mounted on the rear side of the optics side plate. The sensor board is covered by the sensor housing cover which has a small hole to allow light reflected from the original to reach the ADS sensor.

ADS Sensor Gain Adjustment (Every 1,000 Copies)

To maintain consistent image quality regardless of changes in the components of the optic path with time, the ADS sensor reference voltage is adjusted to 2.7 ± 0.1 V every 1K copies. The exposure lamp turns on at ID level 4, and the light reflected by the white ADS pattern [B] reaches the ADS sensor. The CPU adjusts the ADS gain value to make the output (V_{ADS} pattern) equal to 2.7 ± 0.1 V. The gain value is stored in the RAM board.

If the output cannot be made to equal 2.7 ± 0.1 Volts even if the gain is adjusted as far as it will go, the machine generates a Service Call code.



During Copying

To maintain good copy quality, the development bias changes depending on the background density detected by the ADS sensor.

In full size mode when the user selects ADS, the CPU samples the ADS sensor output across the original from 5 mm to 15 mm from the left scale edge. The CPU takes the maximum ADS sensor output during the sampling period and compares it with the ADS reference voltage (V_{ADS} [pattern]; see the previous page). Based on this comparison, the machine may adjust the development bias to eliminate dirty background (see the Process Control - ADS Correction section for details).

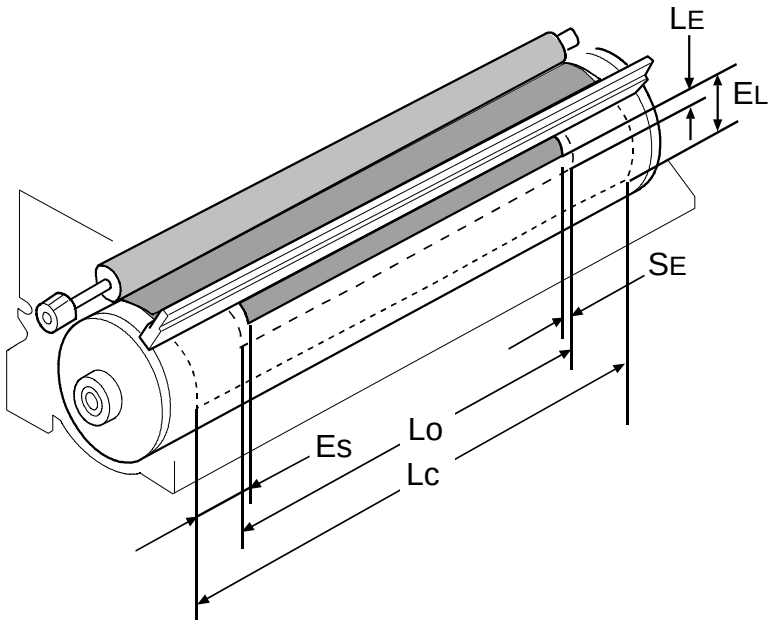
The sampling length of the ADS sensor output for the original differs depending on the reproduction ratio because the scanner speed is different.

Sampling is performed on each copy. (If more than one copy is made of the same original, sampling is only done for the first copy run.)

Note: There is an optional extra ADS sensor for users who have copy quality problems with certain types of red original. (See FSM page 3-24)

5. ERASE

5.1 OVERVIEW



LE: Leading edge erase margin: 3.5 ± 2.5 mm
SE: Side erase margin: total of both sides is 3 mm or less
Lo: Original width
Lc: Charged width of the drum
EL: Leading edge erase
Es: Side erase

The erase lamp unit consists of a row of 54 LEDs extending across the full width of the drum. In erase mode (center erase or side erase), the appropriate LEDs turn on in accordance with the modes selected by the user.

5.2 LEADING EDGE AND TRAILING EDGE ERASE

The entire row of LEDs turns on when the main motor turns on. They stay on until the erase margin slightly overlaps the leading edge of the original image on the drum (leading edge erase margin). This prevents the shadow of the original's leading edge from appearing on the copy paper. This leading edge erase margin is also necessary for the leading edge of the copy paper to separate from the hot roller.

When the scanner reaches the return position, the drum charge roller and the exposure lamp turn off. However, the charged length on the drum surface is a little longer than the actual original length to make sure that there is a complete image of the original.

The entire row of LEDs turn on when the trailing edge of the latent image has passed under the erase lamp unit. This prevents developing unnecessary parts of the drum surface, reducing toner consumption and the drum cleaning load.

The LEDs stay on to erase the leading edge of the latent image in the next copy cycle. After the final copy, the erase lamps turn off at the same time as the main motor.

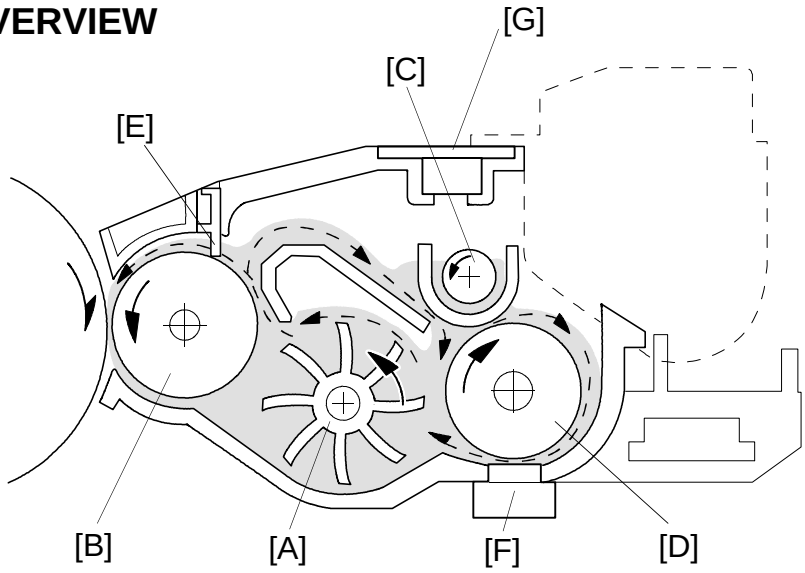
The leading and trailing edge margins can be adjusted with SP2-101-001 and SP2-101-002 respectively.

5.3 SIDE ERASE

Based on the combination of copy paper size and the reproduction ratio, the LEDs turn on in blocks. This prevents the shadow of the original side edge and the unexposed front and rear sides of the drum surface in reduction mode from being developed. This reduces toner consumption and the drum cleaning load.

6. DEVELOPMENT

6.1 OVERVIEW



When main motor rotation is transmitted to the development unit, the paddle roller [A], development roller [B], auger [C], and agitator [D] start turning. The paddle roller picks up developer in its paddles and transports it to the development roller. Internal permanent magnets in the development roller attract the developer (which is about 70 μm in diameter) to the development roller sleeve.

The turning sleeve of the development roller then carries the developer past the doctor blade [E]. The doctor blade trims the developer to the desired thickness and creates developer backspill into the cross-mixing mechanism.

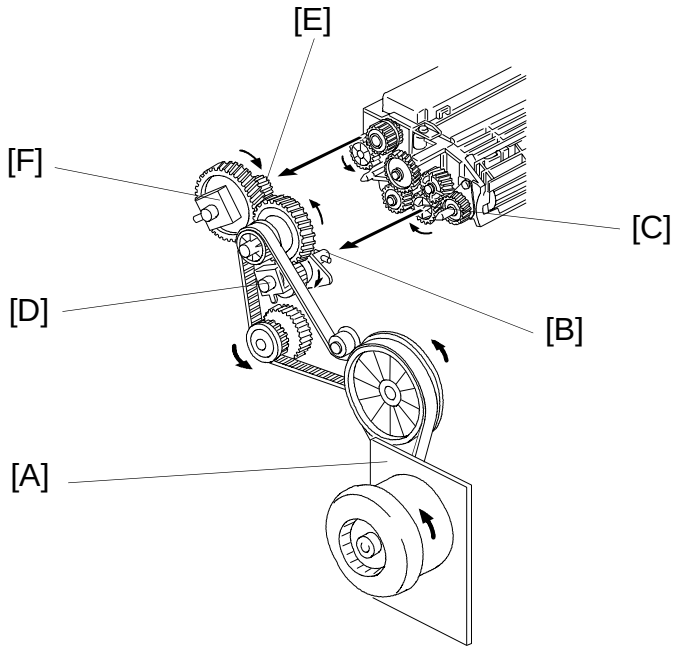
The development roller continues to turn, carrying the developer to the OPC drum. When the developer brush contacts the drum surface, the negatively charged areas of the drum surface attract and hold the positively charged toner. In this way, the latent image is developed.

Negative bias is applied to the development roller to prevent toner from being attracted to the non-image areas on the drum, which may have a residual negative charge. The bias also controls image density.

After turning about 100 degrees more, the development roller releases the developer into the development unit. The developer is agitated by the paddle roller, agitator, and cross-mixing mechanism.

The toner density sensor [F] located under the unit measures the toner concentration in the developer. A hole, fitted with a filter [G], has been made in the top of the unit to relieve air pressure and to minimize toner scattering.

6.2 DRIVE MECHANISM

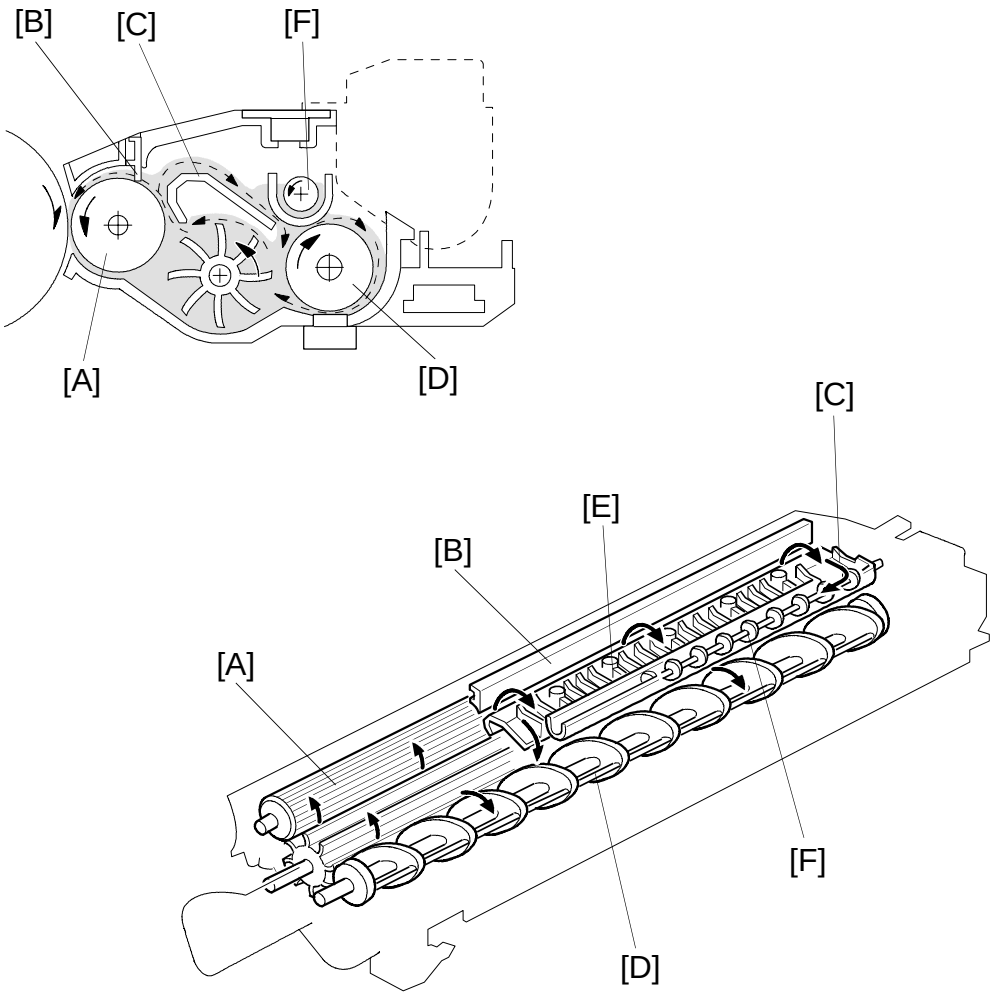


When the main motor [A] turns, the rotation is transmitted from the development drive shaft [B] to the paddle roller gear [C] through the development clutch [D].

The gears of the toner supply unit are driven by the toner supply roller drive gear [E] when the toner supply clutch [F] activates.

All gears on the development unit are helical gears. These gears are quieter than normal gears. The development drive shaft engages the development roller gear when the development unit is pushed in.

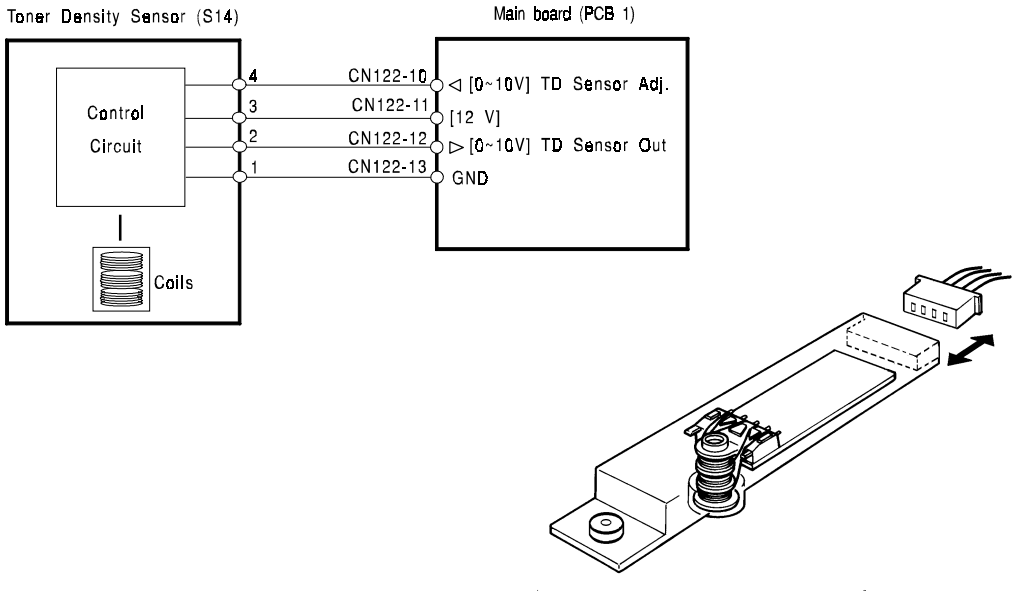
6.3 CROSS-MIXING



This copier uses a standard cross-mixing mechanism to keep the toner and developer evenly mixed. The developer on the turning development roller [A] is split into two parts by the doctor blade [B]. The part that stays on the development roller forms the magnetic brush and develops the latent image on the drum. The part that is trimmed off by the doctor blade goes to the backspill plate [C].

As the developer slides down the backspill plate to the agitator [D], the mixing vanes [E] move it slightly toward the rear of the unit. Part of the developer falls into the auger inlet and is transported to the front of the unit by the auger [F]. As a result of this mechanism, the developer stays level in the development unit.

6.4 TONER DENSITY SENSOR



A toner density sensor (the TD sensor) is installed under the development unit. It works in conjuction with the ID sensor to control the amount of toner in the developer mixture.

The toner density sensor has two basic functions. First, it controls the toner supply when the toner density is greater than the upper limit or less than the lower limit. The ID sensor input is ignored. If the amount of toner in the developer is greater than the upper limit (in this case, if the toner density sensor output, Vt, is less than 1.5V), toner supply is prohibited. Second, it takes over toner supply control completely when TD sensor supply mode is selected with SP2-208-001.

The toner density sensor receives 12 volts from CN122-11 of the main board. The sensor's sensitivity is set by the control signal applied at CN122-10. The input signal from the sensor comes in at CN122-12. This is an analog signal. When the toner density is within the standard range, the analog signal is within the range given below. In this model, the ID sensor has more priority over toner supply control than the TD sensor, so the TD sensor does not have to be controlled so precisely. As a result, the standard range is wider than in previous models.

Standard Range: $1.5V \leq Vt \leq$ [Initial Setting $(2.5 \pm 0.1) + 1.0$] V

The active sensing element is a very small transformer with three coils. When iron ferrite (carrier) is near the sensing element, the inductance of the coils changes, causing the current through the transformer to change. As the amount of toner in the developer increases, the effect of the carrier particles decreases and the voltage applied to CN122-12 decreases. Conversely, when sensor coils increases and the voltage at CN122-12 also increases.

6.5 DEVELOPMENT BIAS CONTROL

The actual development bias voltage applied depends on various process control corrections that are added to the base voltage. These are explained in Process Control section (see the Summary section for a quick-look reference).

In addition, the technician can adjust the base development bias voltage using SP mode 2-201-001 as shown below.

SP2-201-1 Setting	1	2	3	4	*5	6	7	8	9
Development Bias Correction Voltage	+80 V	+60 V	+40 V	+20 V	±0 V	–20 V	–40 V	–60 V	–80 V

Darker ⟷ Lighter

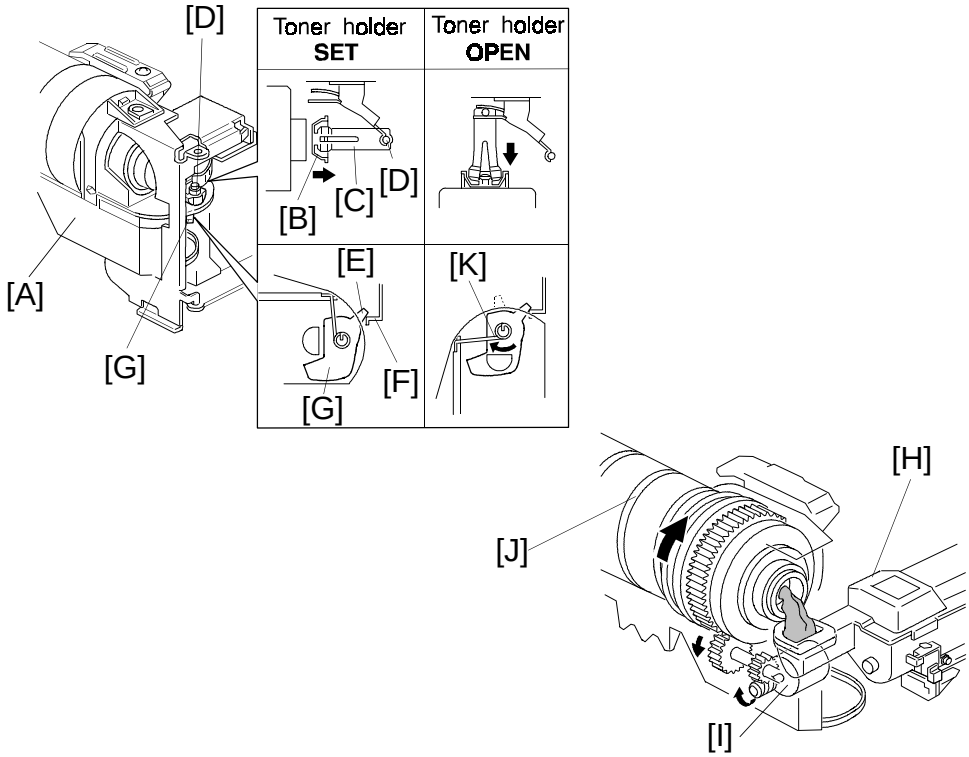
*: Factory setting

This adjustment should be done only if exposure lamp voltage adjustment (SP4-001) fails to achieve the desired image density.

The correction selected here does not affect toner supply control or pattern detection, as it is not applied when developing sensor patterns on the drum, and the bias control system is different (see Process Control for full details).

6.6 TONER SUPPLY

6.6.1 Toner Bottle Replenishment Mechanism



When a toner cartridge is placed on the holder unit [A] and pushed back in completely, the following procedures are automatically performed to supply toner to the toner supply unit.

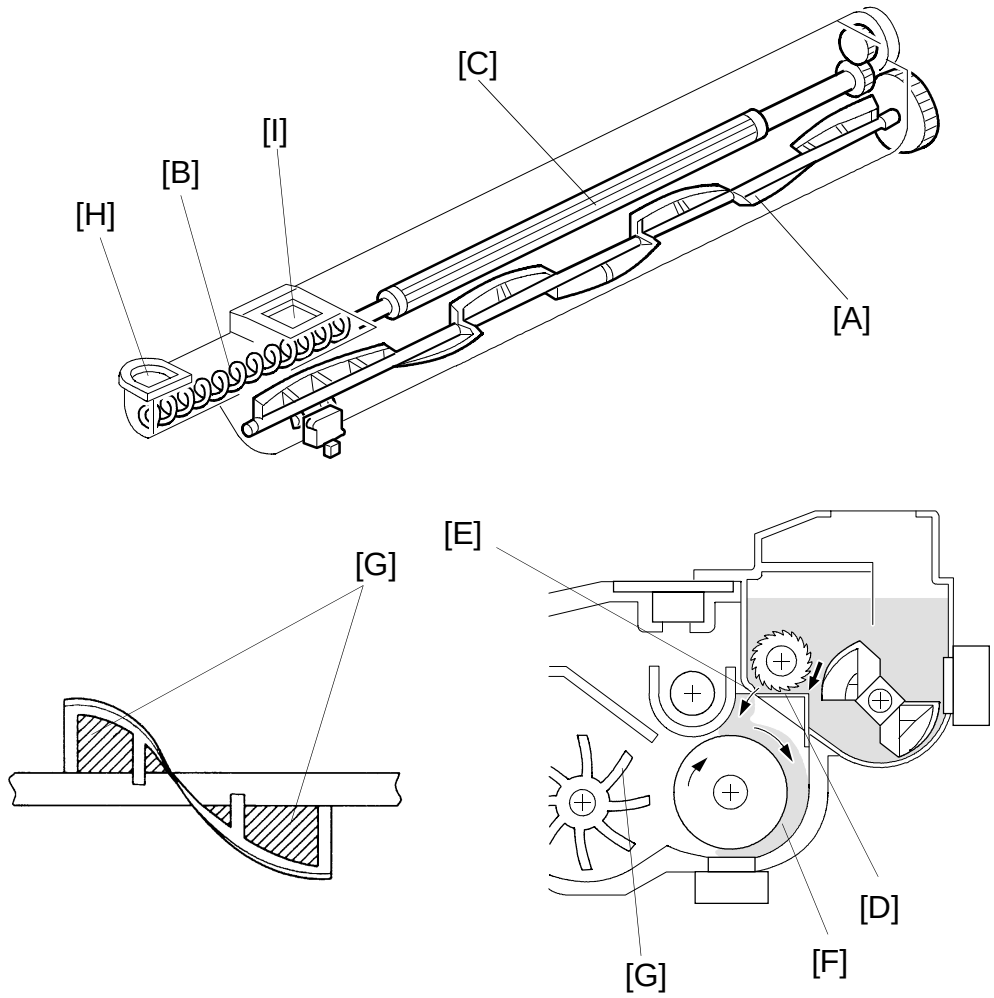
- The cap [B] remaining on the toner bottle is pulled away and kept by the chuck [C] away from the movement of the roller [D], which rides along the curved rail.
- The toner shutter lever [E] meets the bracket [F] on the copier frame and the toner shutter [G], which covers the hole above the toner supply unit opening, is opened.

The bottle drive mechanism transports toner from the bottle to the toner supply unit [H]. A worm gear on the bottle drive motor [I] drives this mechanism. The toner bottle has a spiral groove [J] that helps move toner to the toner supply unit.

When the holder unit is pulled out to add new toner, the following procedures are performed automatically to prevent toner from scattering.

- The chuck releases the toner bottle cap into its proper position.
- The toner shutter shuts the opening as a result of the pressure of the torsion spring [K].

6.6.2 Toner Supply Mechanism



Inside the toner supply unit there are the agitator [A], transport screw [B] and toner supply roller [C]. As the grooves [D] in the toner supply roller turn past the slit [E], toner falls into the development unit [F]. The slit is made up of 21 openings each 0.6 mm in diameter. The agitator has openings [G] inside its fins to achieve a higher degree of mixing.

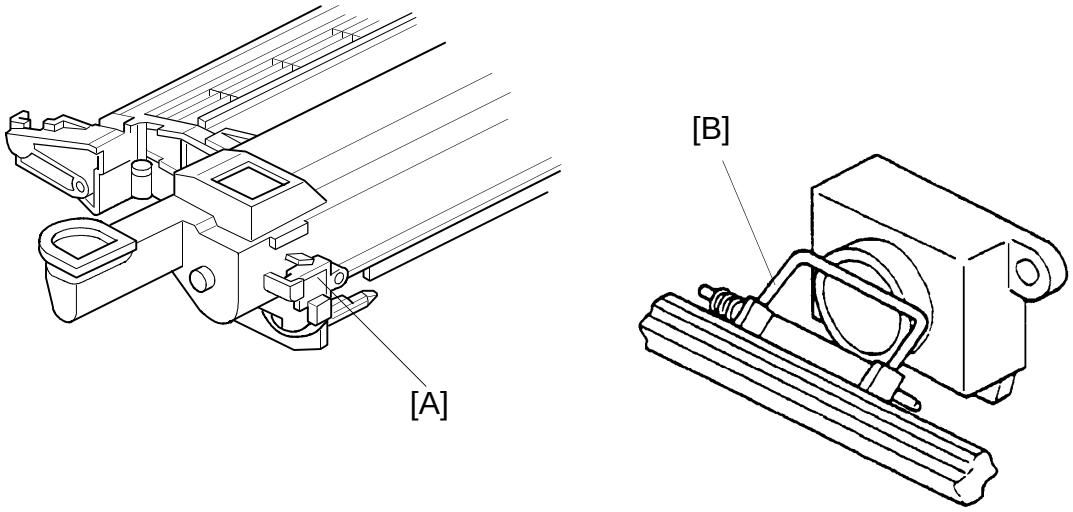
Two openings can be found in this toner supply unit to supply toner. One [H] is for **new** toner from the toner bottle, and the other [I] is for **used** toner from the toner recycling system.

The toner supply clutch transfers rotation from the main motor to the agitator gear, which drives the toner supply roller. Both toners are mixed together and transported from the front to the rear; under ideal conditions, the proportions of the two types of toner will be about 80% new toner to 20% recycled toner.

For more details on toner recycling, see the Toner Recycling section.

For more details on toner supply control, see the Process Control Section.

6.6.3 Toner End Detection



The toner end sensor (which is a piezoelectric sensor) [A] detects whether there is sufficient toner in the toner supply unit or not.

When there is not much toner inside the toner supply unit, the pressure of toner on the toner end sensor becomes low and the sensor outputs a low signal (0V); this is the low toner condition. When this condition is detected five times, the toner bottle is turned for 2 seconds to add toner.

While the toner bottle is being turned to add toner, the CPU counts the total toner supply clutch on time since the low toner condition was first detected. If the toner end sensor is still outputting a low signal when the total clutch on time reaches one minute, the Add Toner indicator starts blinking, and the machine enters the toner near-end condition.

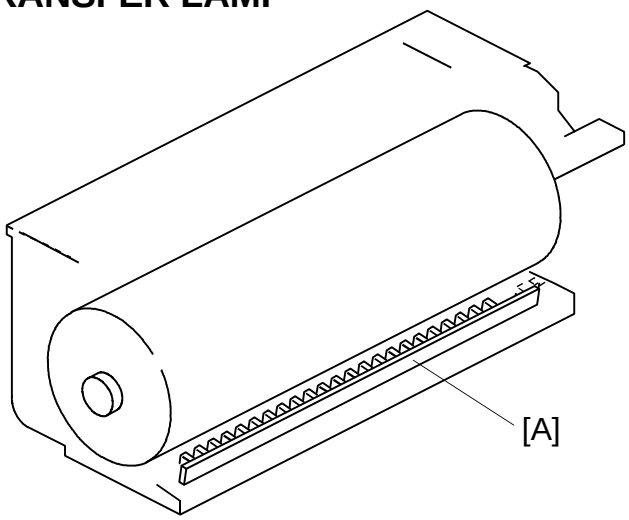
Fifty copies are allowed after entering the toner near-end condition. After this, the machine enters the toner end condition and copying is disabled.

When the main switch is turned off and on, or the front door is opened and closed, the machine drives the toner supply mechanism and monitors the toner end sensor output. (The toner supply mechanism will be driven for a maximum of 10 seconds.) If the toner end sensor outputs a high signal (5V), the toner end condition is canceled.

The toner end sensor surface is cleaned by the movement of the spring [B] attached to the agitator shaft.

7. IMAGE TRANSFER AND PAPER SEPARATION

7.1 PRE-TRANSFER LAMP

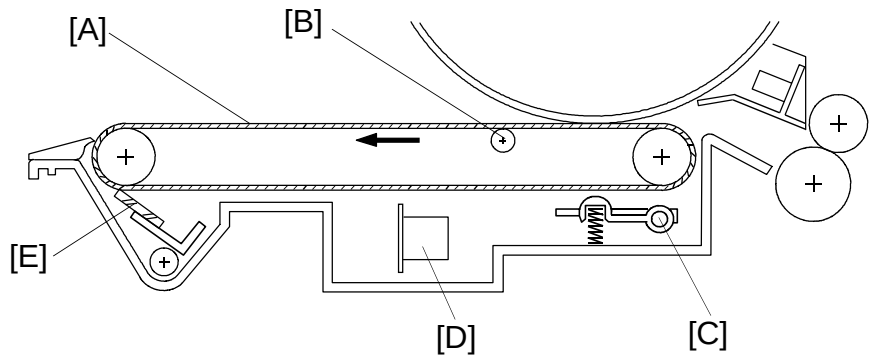


The pre-transfer lamp [A] prevents incomplete toner transfer. This lamp consists of a line of 40 LEDs.

After the latent image is developed but before the image is transferred to the copy paper, the drum surface is illuminated by the pre-transfer lamp. This illumination further reduces the negative potential on the drum surface after it has been partially discharged by exposure. This makes image transfer easier.

The pre-transfer lamp turns on and off at the same time as the main motor.

7.2 IMAGE TRANSFER AND PAPER SEPARATION



This model uses a transfer belt unit instead of a transfer and separation corona unit. The transfer belt unit consists of the following parts:

[A] Transfer belt
A belt (length: 334 mm for A153, A155, and A156 copiers; 244.5 mm for A157, A159, and A160 copiers) with high electrical resistance which holds a high negative electrical potential and attracts the toner from the OPC drum onto the paper. Also the electrical potential attracts the paper itself and helps to separate the paper from the OPC drum.

[B] Transfer bias roller
Applies transfer voltage to the transfer belt.

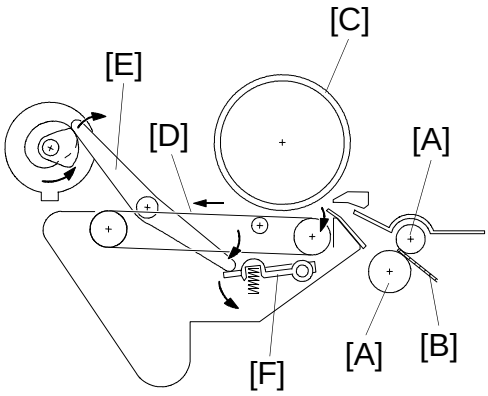
[C] Transfer belt lift lever (driven by a one-third turn clutch)
Lifts the transfer belt into contact with the OPC drum.

[D] Transfer high voltage supply board
Generates a constant transfer current.

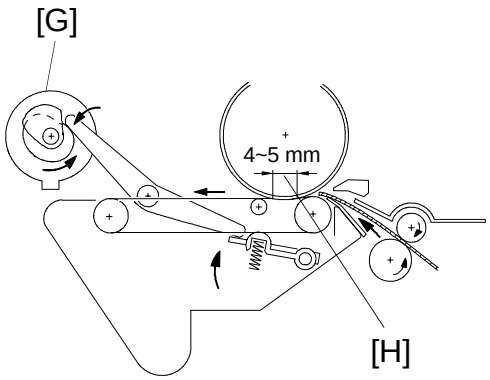
[E] Transfer belt cleaning blade
Removes toner from the transfer belt to prevent the back side of the paper from being stained.

7.3 IMAGE TRANSFER AND PAPER SEPARATION MECHANISM

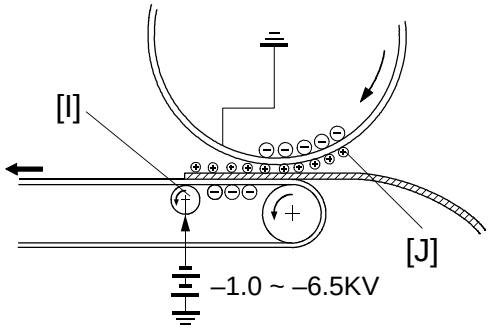
(1) The registration rollers [A] start feeding the paper [B] to the gap between the OPC drum [C] and the transfer belt [D] at the proper time. The transfer belt does not contact the OPC drum at this moment (the on-off lever [E] pushes down the transfer belt lift lever [F]).



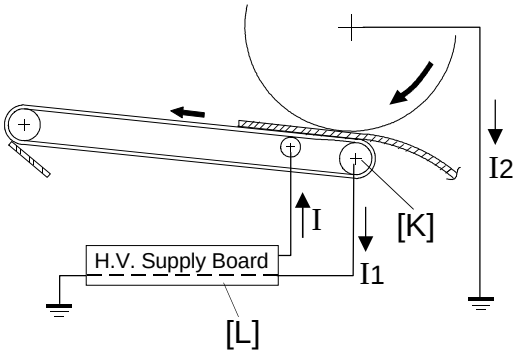
(2) Before the leading edge of the paper reaches the gap between the transfer belt and the OPC drum, the transfer belt contact clutch [G] rotates one third of a complete rotation to release the on-off lever. Then, the transfer belt lift lever pushes up the transfer belt as a result of spring pressure. The contact width [H] is about 4 ~ 5 mm.



(3) Then a negative potential of –1.0 ~ –6.5 kilovolts is applied to the transfer bias roller [I]. The negative charge attracts the positively charged toner [J] from the OPC drum. It also attracts the paper and separates the paper from the OPC drum.

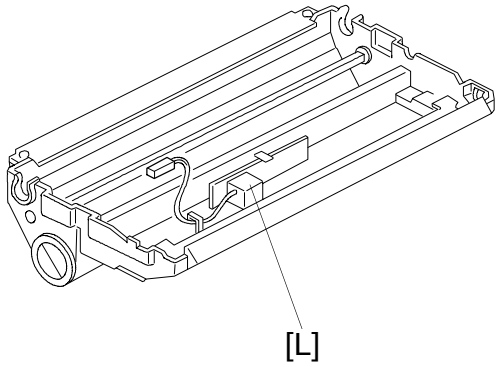


(4) After the image transfer is completed, the charge on the transfer belt holds the paper on the transfer belt. Excess charge on the paper and the transfer belt is discharged during rotation via the grounded idle roller [K].

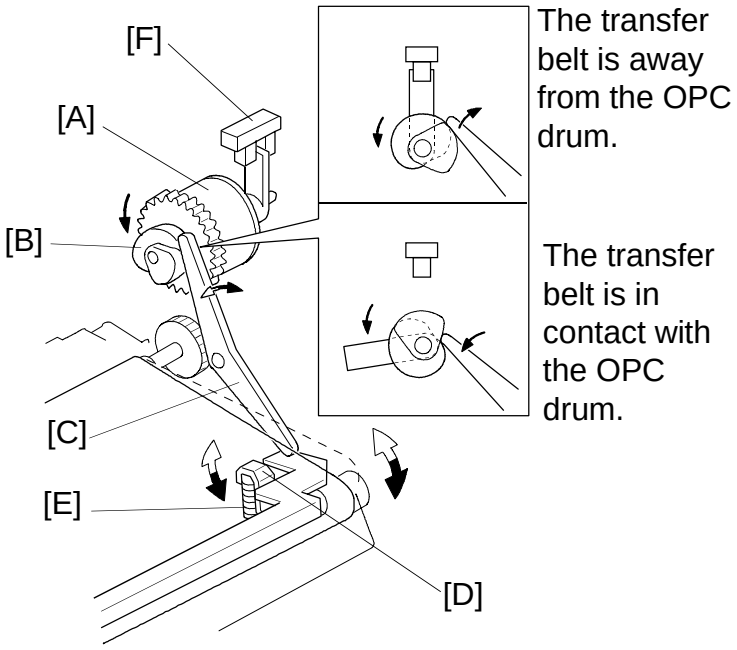


$I_2 = I - I_1$ = constant

When the transfer high voltage supply board [L] inside the transfer belt unit provides high voltage to the transfer bias roller, a small current (I_2) flows to ground via the transfer belt, the paper, and the OPC drum. It is important that this current stays constant even if the paper, environmental conditions, or the transfer belt surface resistance change. The positive feedback of I_1 to the power supply board causes the voltage to increase and decrease with I_1 so that (I_2) remains constant. (The relationship is $I_2 = I - I_1$.)



7.4 TRANSFER BELT UNIT LIFT MECHANISM

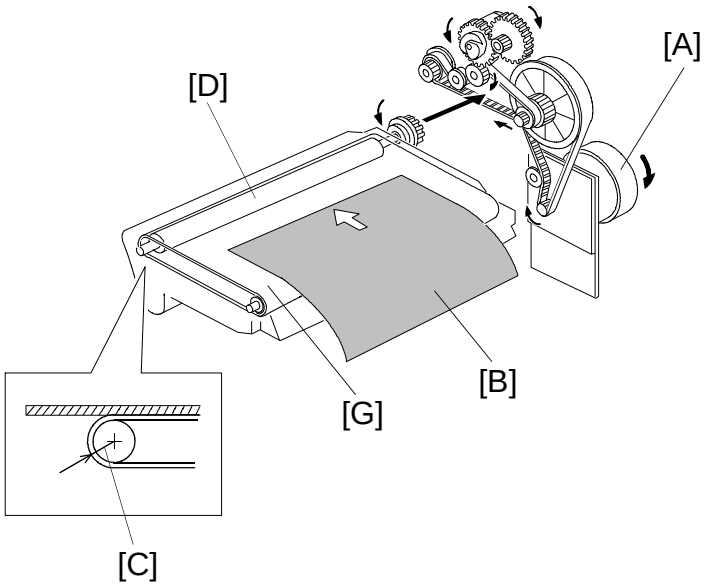


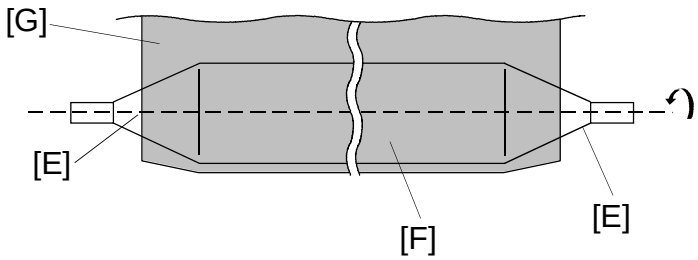
The transfer belt contact clutch [A] (a one-third turn clutch) located on the back of the copier turns on and the cam [B] rotates one third of a complete rotation. The on-off lever [C], riding on the cam, rotates counterclockwise to release the transfer lift lever [D]. Then, the springs [E] push up the transfer belt lift lever and the transfer belt to make the transfer belt contact the OPC drum.

The transfer belt contact home position sensor [F] is used to detect the home position of the cam (this is when the transfer belt is away from the OPC drum). The transfer belt must be released from the OPC drum while it is not being used for image transfer. The reasons are as follows:

- To prevent V_{SP}, V_L, and V_R patterns on the OPC drum from being rubbed off by the transfer belt, because the transfer belt is located between the development unit and the ID sensor.
- To prevent a change in the OPC drum characteristics because of the influence of additives inside the rubber belt.

7.5 PAPER TRANSPORTATION AND BELT DRIVE MECHANISM



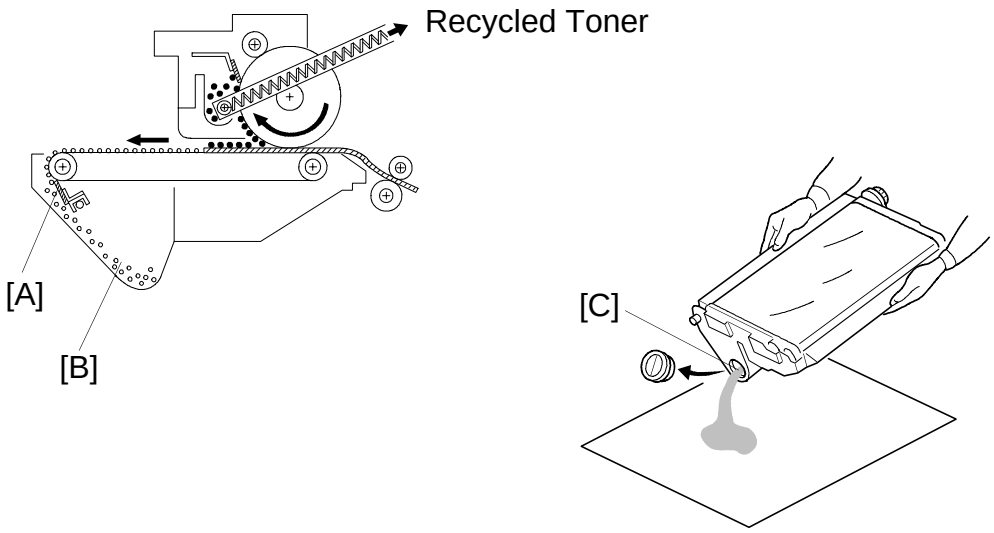


The main motor [A] drives the transfer belt through some timing belts and gears. Since the transfer belt electrically attracts the paper [B], a transport fan is not required.

As a result of its own stiffness and the curvature [C] of the belt, the paper separates from the transfer belt above the transfer belt drive roller [D] as the belt turns sharply around the transfer belt drive roller.

The tapered parts [E] at both sides of the drive roller [F] help keep the transfer belt [G] at the center position.

7.6 TRANSFER BELT CLEANING MECHANISM



Some toner may adhere to the transfer belt under the following conditions:

- When a paper jam occurs.
- When the by-pass feed table side fences are set wider than the actual paper width. In this condition, the erase lamp does not erase the area of the drum outside the width of the copy paper. The image developed on this area will not be transferred to the copy paper but to the transfer belt.
- When the platen cover or ADF is opened during the first copy when using by-pass feed. In this condition, the scanner scans full size and a full black image is developed outside the length of the copy paper. The developed image on this area will not be transferred to the copy paper but to the transfer belt instead.

The adhering toner must be removed to prevent the back side of later copies from being stained. The cleaning blade [A], which is always in contact with the transfer belt, scrapes off any toner remaining on the transfer belt. Paper dust on the transfer belt is also scraped off, and is disposed of with the waste toner from the transfer belt. A counter blade system is used to clean the transfer belt. The surface of the transfer belt is coated to make it smooth and to prevent the cleaning blade from being flipped by the transfer belt.

The toner that is scraped off falls into the toner collection tank [B]. Collected toner must be discarded from the opening [C] at each preventive maintenance call. This toner must not be recycled, because it contains paper dust.

During the following modes, the transfer belt unit is away from the drum while the transfer belt is rotated.

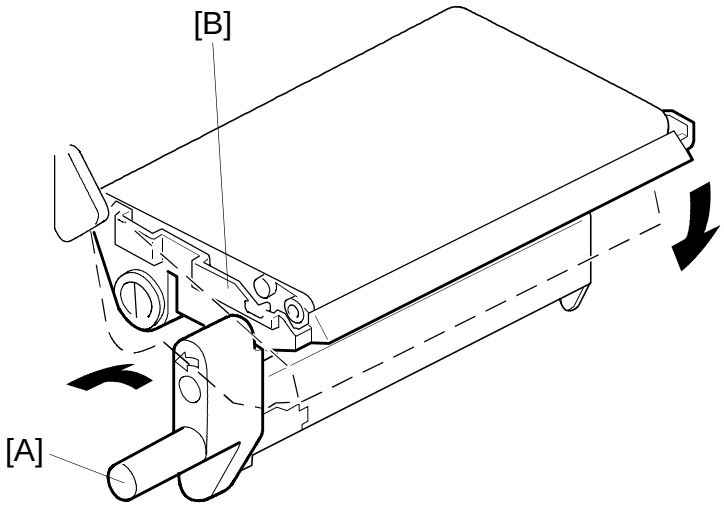
- 1,000 copies process control
- Stacking paper in the duplex unit
- Drum charge roller cleaning
- Fusing idling
- Toner end recovery

The transfer belt cleaning blade scrapes off any toner remaining on the transfer belt, but some toner will be stuck in very small cracks in the transfer belt (these small cracks are a normal characteristic of the transfer belt).

If there is some negative toner in these cracks, there may be some side effects, such as the back sides of copies getting dirty. This is because the negative transfer voltage repels the negatively-charged toner, and this toner becomes attracted to the back of the copy paper.

After any of the above-stated five modes, to prevent these side effects, the transfer belt comes into contact with the drum and rotates for 2 seconds while applying the transfer bias voltage (–1.0 ~ –6.5 kV). As a result of this negative charge, the negatively-charged toner is repelled and is attracted to the drum. This toner is then scraped off by the drum cleaning blade.

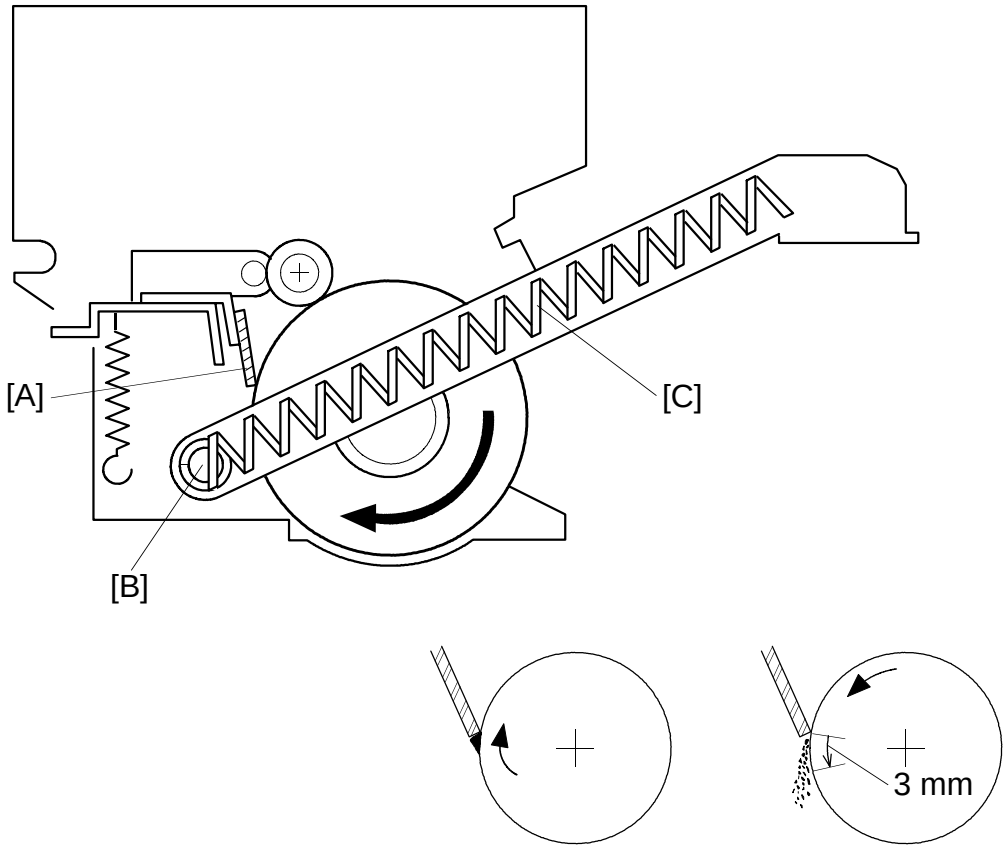
7.7 TRANSFER BELT UNIT RELEASE MECHANISM



When the transfer belt unit release lever "A1" [A] is rotated counterclockwise, the transfer belt unit [B] is released, allowing it to rotate down clockwise. This mechanism allows easy paper jam recovery and easy maintenance of the transfer belt unit.

8. DRUM CLEANING

8.1 OVERVIEW

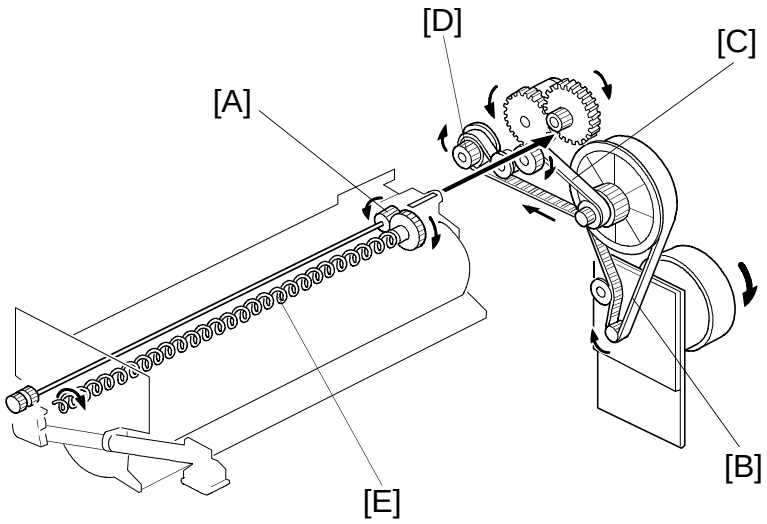


This copier uses a counter blade system for drum cleaning. In a counter blade system, the blade [A] is angled against drum rotation. This system has the advantage of high cleaning efficiency.

The toner remaining on the drum is scraped off by the cleaning blade and it falls onto the toner collection coil [B]. Collected toner is transported to the recycled toner transport coil [C].

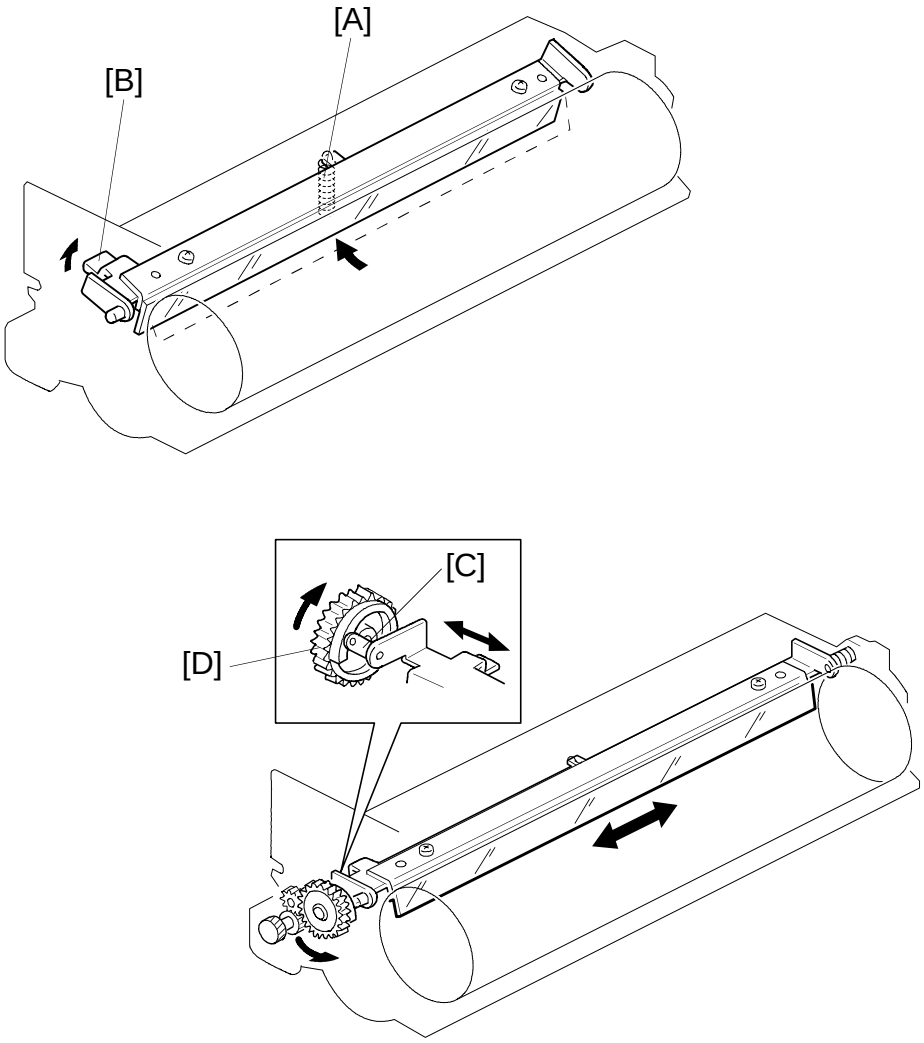
To remove the toner that is accumulated at the edge of the cleaning blade, the drum turns in reverse for about 3 mm at the end of every copying job.

8.2 DRIVE MECHANISM



Drive from the main motor is transmitted to the cleaning unit drive gear [A] by the timing belts [B] and [C] and the joint gear [D]. The cleaning unit drive gear [A] then transmits the drive to the toner collection coil [E]. The two gears at the front end of the cleaning unit drive gear shaft are used to move the cleaning blade from side to side and to drive the recycled toner transport coil.

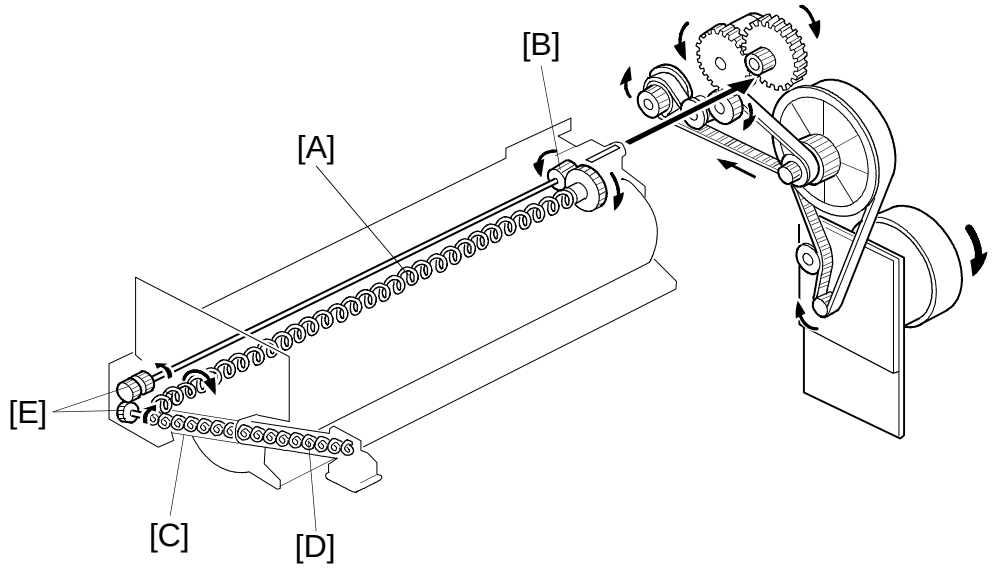
8.3 CLEANING BLADE PRESSURE MECHANISM AND SIDE-TO-SIDE MOVEMENT



The spring [A] always pushes the cleaning blade against the OPC drum. The cleaning blade pressure can be manually released by pushing up the release lever [B]. To prevent cleaning blade deformation during transportation, the release lever is locked in the pressure release (upper) position.

The pin [C] at the front end of the cleaning blade holder touches the inner rim of the sinusoidal cam gear [D] which gives a side-to-side movement to the blade. This movement helps to disperse accumulated toner to prevent early blade edge deterioration.

8.4 TONER COLLECTION MECHANISM

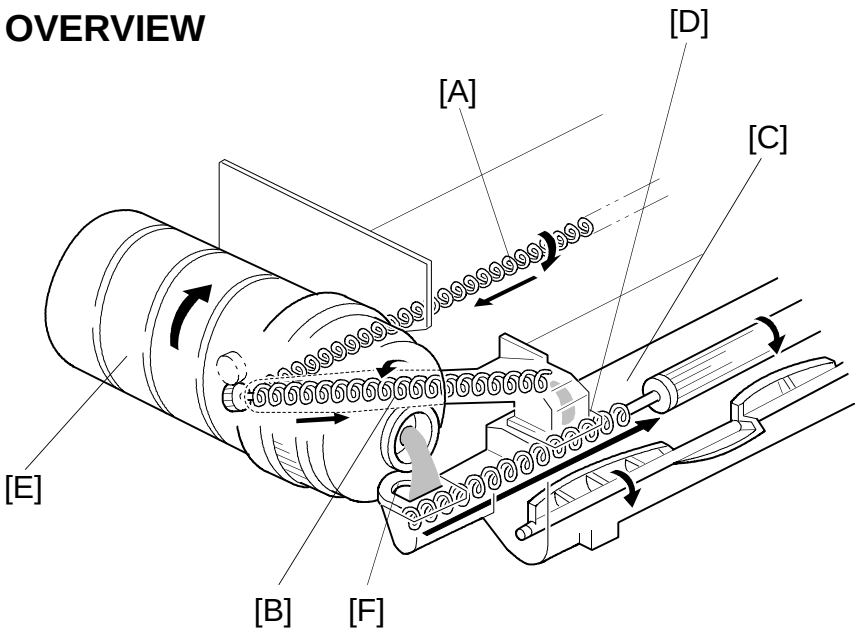


Toner scraped off by the cleaning blade falls onto the toner collection coil [A]. The toner collection coil is driven by the main motor via the cleaning unit drive gear [B].

The toner collection coil transports toner to where it joins the recycled toner transport tube [C] at the front of the drum unit. The recycled toner transport coil [D] is driven by two helical gears [E], one of which is on the front end of the cleaning unit drive gear shaft and the other on the shaft of the recycled toner transport coil. The recycled toner transport coil moves collected toner to the toner supply unit for recycling. (See the "Toner Recycling" section for details.)

9. TONER RECYCLING

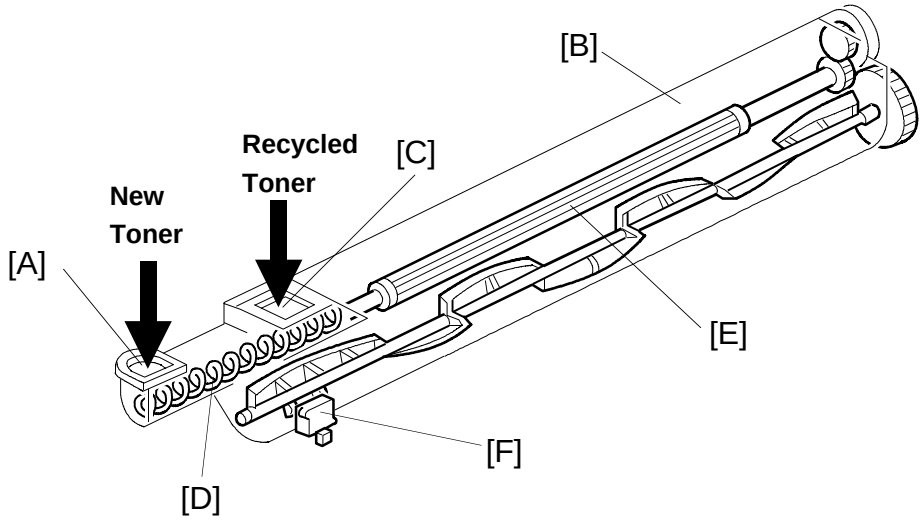
9.1 OVERVIEW



As described in the "Drum Cleaning" section, the toner remaining on the drum which was not transferred to the copy paper is scraped off by the cleaning blade and falls onto the toner collection coil [A].

The toner collection coil carries the toner to the recycled toner transport coil [B]. This helical coil transports the collected recycled toner to the toner supply unit [C] through the opening [D]. In addition, new toner is supplied from the toner bottle [E] into the toner supply unit through the opening [F]. (Refer to the "Toner Bottle Replenishment Mechanism" section.)

9.2 NEW TONER AND RECYCLED TONER MIXTURE



The mixture ratio of new toner and recycled toner affects copy quality.

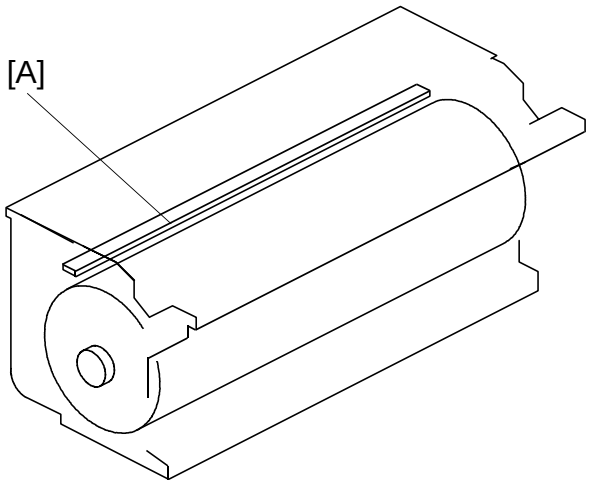
New toner is supplied from the toner bottle to the opening [A] in the toner supply unit [B] when the toner bottle drive motor rotates.

Recycled toner is transported to the opening [C] when the toner collection coil in the cleaning unit and the recycled toner transport coil in the drum unit are driven by the main motor. However, the new toner and the recycled toner stop at the openings [A] and [C] until the transport coil [D] rotates. So the new and recycled toner are only transported into the toner supply unit when the transport coil is driven through the toner supply roller [E]; this occurs when the toner supply clutch turns on while the main motor is running. Therefore, recycled toner and new toner are supplied together to the interior of the toner supply unit.

The transfer ratio of the toner on the OPC drum to the copy paper is about 80%, regardless of the proportion of black in the image. So 20% of the toner always goes to the recycled toner inlet of the toner supply unit. When the toner end sensor [F] indicates that more toner is needed, the toner supply clutch turns on, and this recycled toner goes into the development unit with new toner (about 80% of the mixture will be new toner).

As toner is supplied to the machine on successive occasions, the proportion of recycled toner in the development unit will approach 20% over time, until the developer is changed and the process starts again with all the toner in the development unit being new toner.

10. QUENCHING



In preparation for the next copy cycle, light from the quenching lamp [A] neutralizes any charge remaining on the drum.

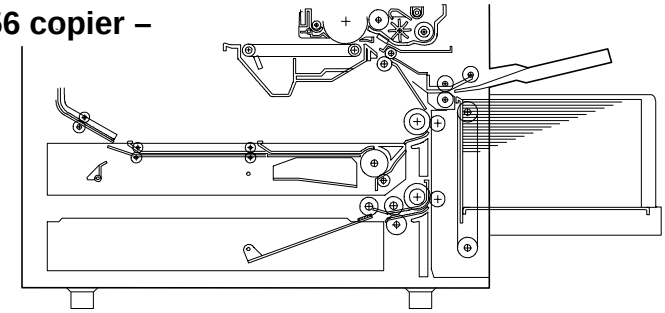
The quenching lamp consists of a line of nine LEDs extending across the full width of the drum.

Red LEDs are used to reduce ultra violet light which would cause light fatigue of the OPC drum.

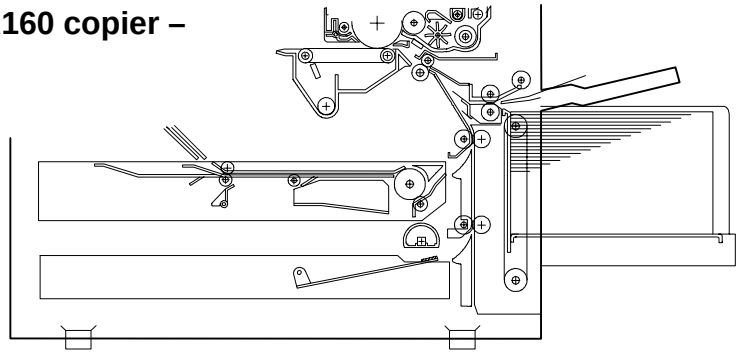
11. PAPER FEED AND REGISTRATION

11.1 OVERVIEW

– A156 copier –



– A160 copier –



This model has three paper feed stations: the large capacity tray feed station (LCT machines only), the upper paper tray feed station (non-duplex machines only) and the lower paper tray feed station.

The LCT holds 1000 sheets of paper. The upper and lower paper trays are drawer trays that hold either 500 sheets of paper (A153/A155/A156 copiers) or 250 sheets of paper (A157/A159/A160 copiers).

Paper can also be fed using the by-pass feed table, which uses the feed mechanism of the LCT feed station. The by-pass feed table can hold 40 sheets of paper.

There are two types of paper feed system: the FRR feed system and the corner separation system.

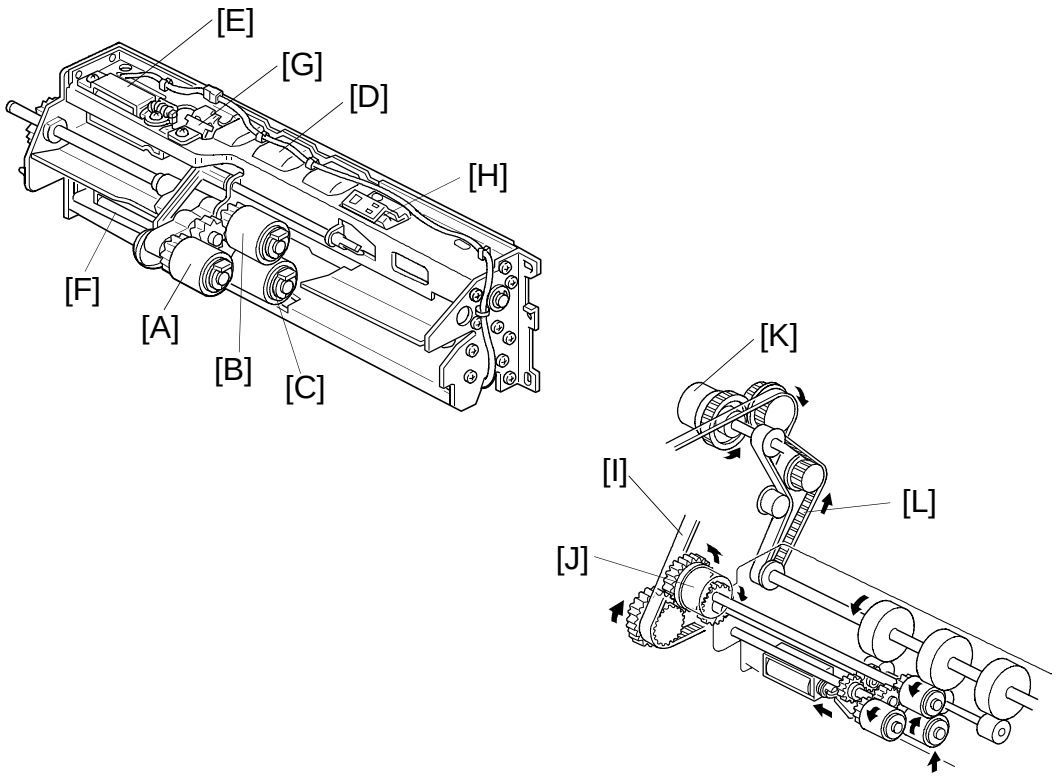
- The FRR feed system is used for the A153/A155/A156 copiers, the LCT and the by-pass feed station.
- The corner separation system is used for the A157/A159/A160 copiers.

The top sheet of paper separates from the stack and is fed to the relay rollers, then to the registration rollers.

There are two relay sensors, one located just under each set of relay rollers. These sensors are used for paper jam detection.

11.2 PAPER FEED MECHANISM [A153/A155/A156]

11.2.1 Drive Mechanism

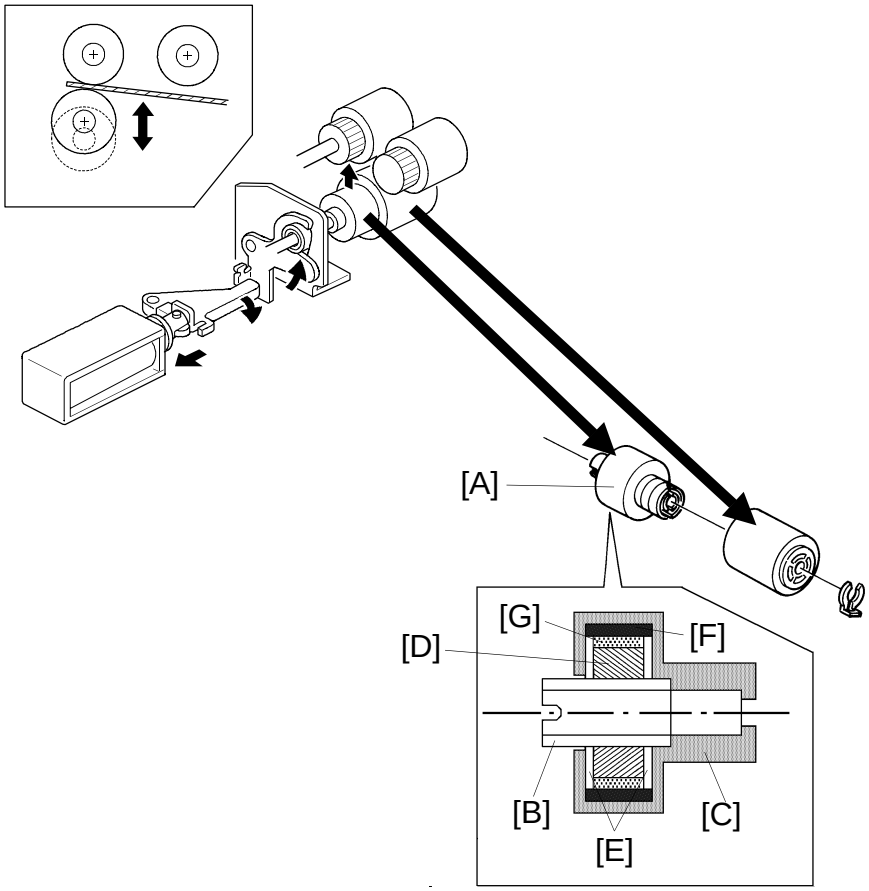


Each paper feed unit consists of a pick-up roller [A], feed roller [B], separation roller [C], relay roller [D], pick-up solenoid [E], separation solenoid [F], paper upper limit sensor [G], and paper end sensor [H].

The pick-up, feed and separation rollers are driven by the main motor via the timing belt [I] and the paper feed clutch [J]. The relay roller is also driven by the main motor. However, drive is transmitted to the relay roller via the relay clutch [K] and the timing belt [L].

In standby mode, the separation roller is away from the feed roller.
At 50 ms after the Start key was pressed, the main motor and the separation roller solenoid of the selected paper feed station turn on. Then the separation roller contacts the feed roller.
At 100 ms after the main motor started to rotate, the pick-up solenoid turns on. The pick-up roller lowers to make contact with the top of the paper stack. The pick-up solenoid stays on for 314 ms.
At 200 ms after the main motor started to rotate, the paper feed clutch and the relay clutch turn on. The feed roller and relay rollers feed the top sheet of the paper stack to the registration rollers. When the leading edge of the paper passes through the upper relay sensor, the paper feed clutch is de-energized.

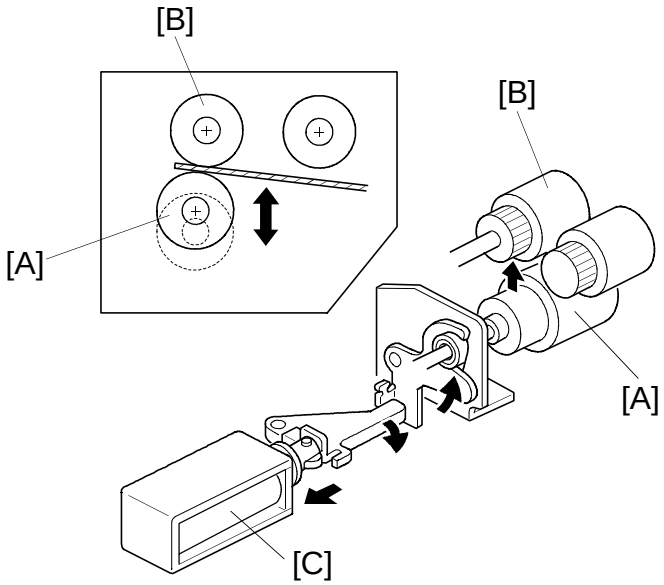
11.2.2 Slip Clutch Mechanism



The separation roller is mounted on a slip clutch. The slip clutch [A] consists of an input hub [B] and an output hub [C], which also acts as the case of the clutch. A magnetic ring [D] and the steel spacers [E] are fitted onto the input hub. A ferrite ring [F] is fitted into the output hub. Ferrite powder [G] packed between the magnetic ring and the ferrite ring generates a constant torque due to magnetic force. The input hub and the output hub slip when the rotational force exceeds the constant torque. The constant torque prevents double feeding, because it exceeds the coefficient of friction between sheets of paper.

This type of slip clutch does not require lubrication.

11.2.3 Separation Roller Release Mechanism

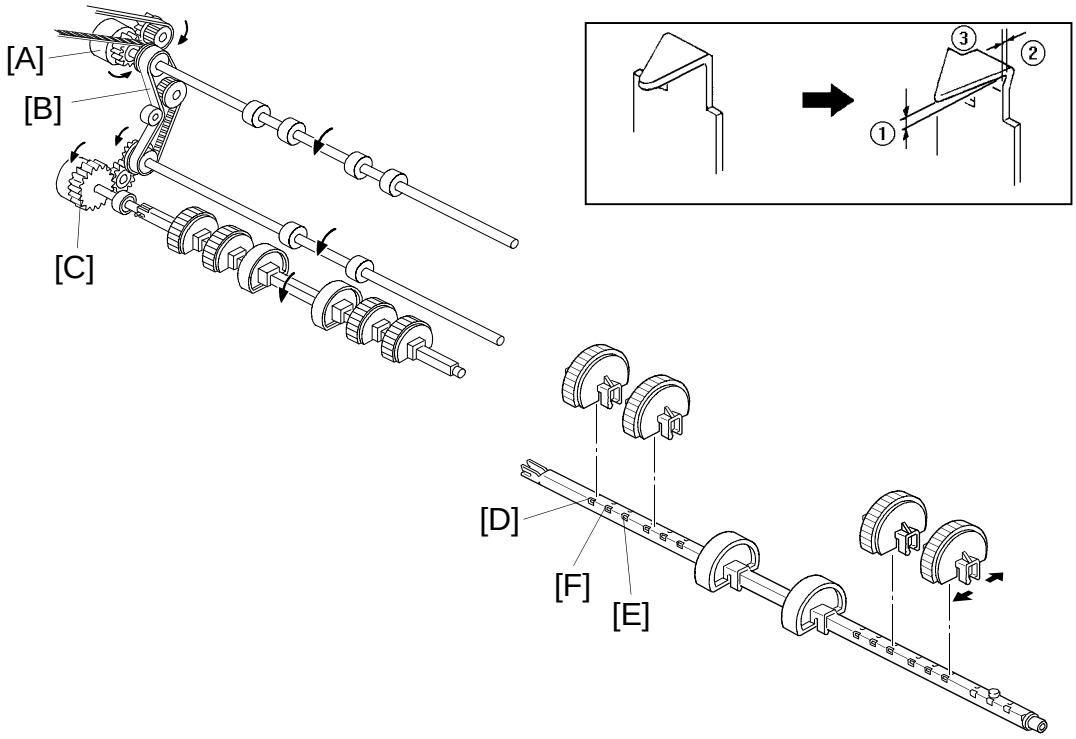


This FRR mechanism uses a separation roller release system. The separation roller [A] is normally away from the feed roller [B]. When the paper feed station has been selected and the Start key is pressed, the separation solenoid [C] moves the separation roller into contact with the feed roller.

This mechanism has the following three advantages:

- If the separation roller is normally away from the feed roller, it reduces the wear on the rubber surface of the separation roller that is caused by friction between the feed roller and the separation roller.
- After paper feeding is completed, a sheet of paper sometimes remains between the feed roller and the separation roller. If the feed tray is drawn out in this condition, it is possible for this sheet of paper to be torn. When the separation roller is away from the feed roller, the remaining sheet of paper is released from between the feed roller and the separation roller.
- When paper misfeeds occur in this area, users can easily pull out paper jammed between the feed roller and the separation roller because the separation roller is away from the feed roller.

11.3 PAPER FEED DRIVE MECHANISM [A157/A159/A160]



The main motor drives the paper feed rollers through the relay clutch gear [A], the timing belt [B] and the paper feed clutch gear [C].

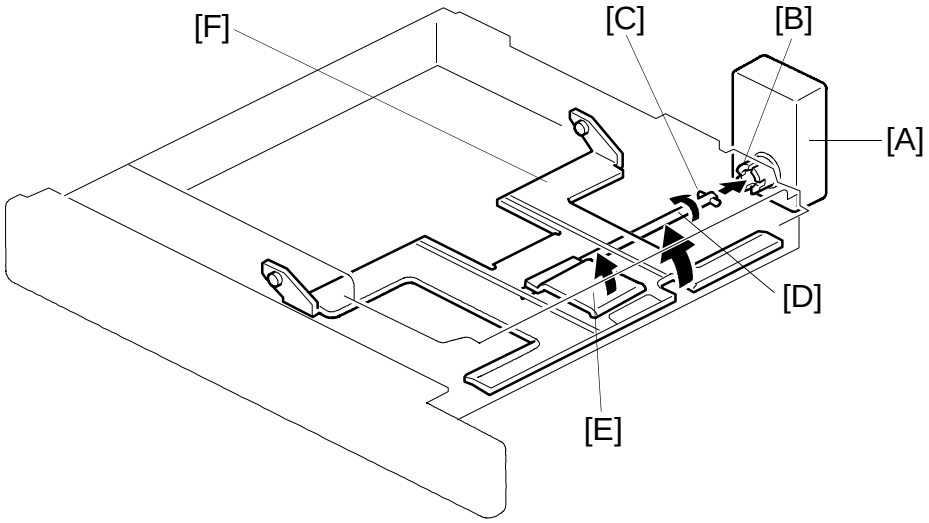
After the Start key is pressed, the paper feed clutch turns on and the paper feed rollers start rotating to feed the paper. The paper feed clutch stays on for 150 ms to turn the paper feed rollers once only (the paper feed clutch is a one-turn clutch).

This paper feed mechanism uses the corner separation system. The shape of the corner separators has been changed as shown above. These corner separators have the following advantages.

- Dog ear problems were reduced by the changes in angles ① and ② .
- Multiple paper feeding was reduced by the change in shape at ③ .

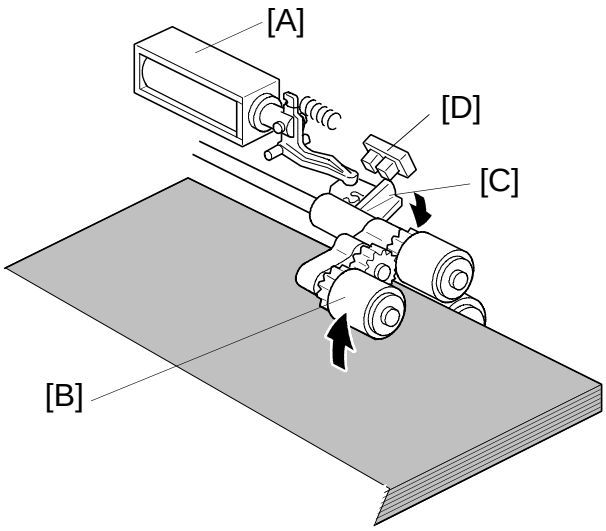
There are two extra holes for each paper feed roller on the paper feed roller shaft for use when multiple feed or paper jams occur. The factory-set position of the paper feed roller is hole [D], which is most suitable for A4, LT and B size paper. Another [E] is especially suitable for B size paper. The other, [F], is a general position that is used in Japan, where people are as likely to use B size paper as A size. If paper jams or non-feed errors occur for users who mainly use B size paper, change the paper feed roller position to [E]

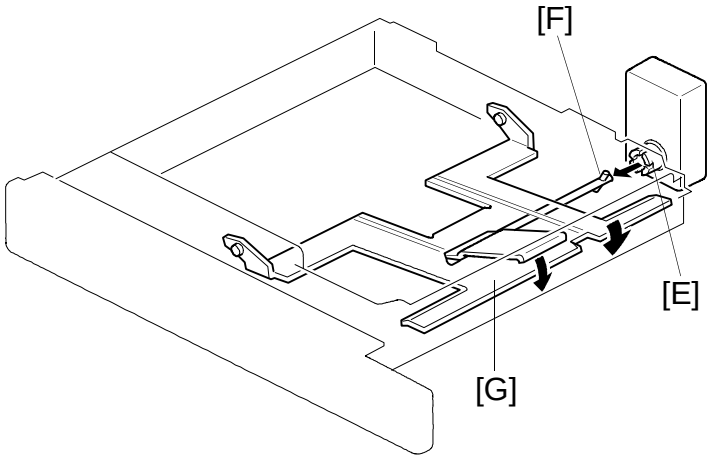
11.4 PAPER LIFT MECHANISM



- A153/A155/A156 copiers -

The tray switch detects when the tray is placed in the machine. When the machine detects that the paper tray is in the machine, the tray lift motor [A] rotates and the coupling gear [B] on the tray lift motor engages the pin [C] of the lift arm shaft [D]. Then the tray lift arm [E] lifts the tray bottom plate [F].

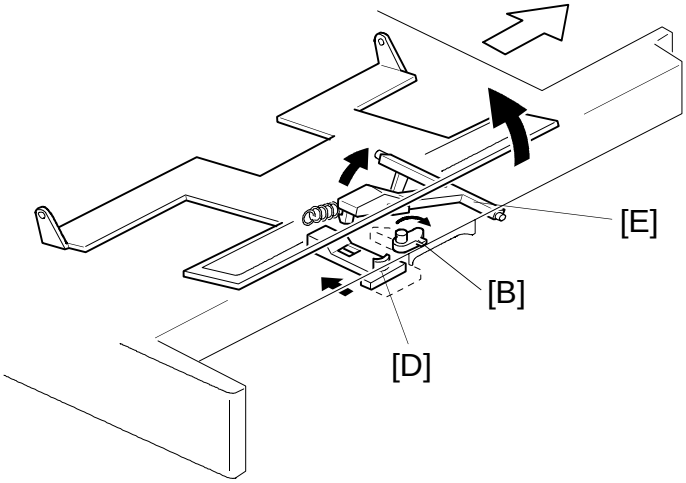


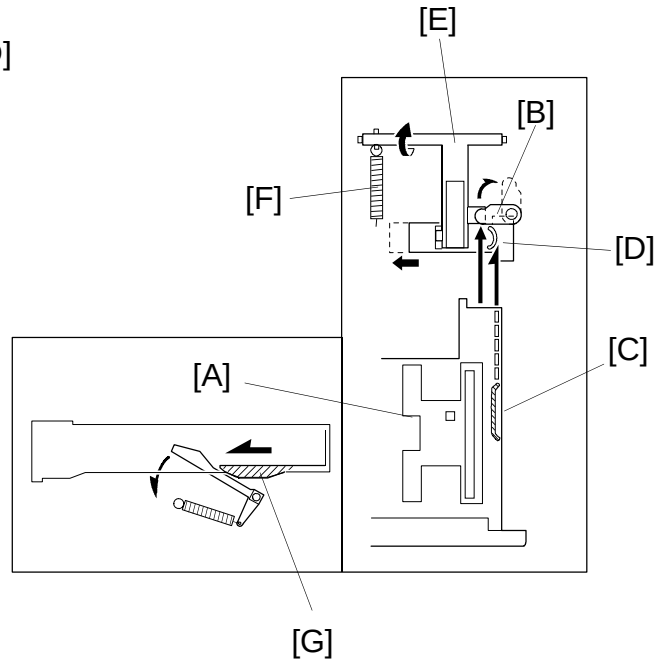


When the tray lift motor turns on, the pick-up solenoid [A] activates to lower the pick-up roller [B]. When the top sheet of paper reaches the proper height for paper feed, the paper pushes up the pick-up roller and the actuator [C] on the pick-up roller supporter activates the paper upper limit sensor [D] to stop the tray lift motor.

After several paper feed cycles, the paper level gradually lowers and the upper limit sensor is de-activated. The tray lift motor turns on again until this sensor is activated again.

When the tray is drawn out of the machine, the tray lift motor coupling gear [E] disengages the pin [F] of the lift arm shaft, and the tray bottom plate [G] then drops under its own weight.





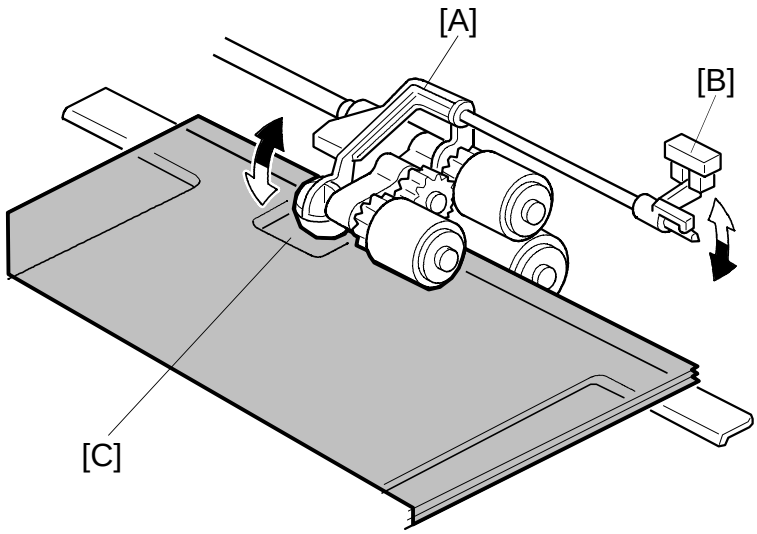
- A157/A159/A160 copiers -

When the paper tray is closed, the projection [A] on the tray pushes the release lever [B], and the other projection [C] pushes the release slider [D]. Then the release slider comes off the bottom plate lift arm [E].

Once the release slider comes off, the spring [F] raises the bottom plate lift arm and the bottom plate is lifted up. Then the top sheet of paper pushes up the corner separators. This keeps the stack of paper at the correct height.

When the tray is pulled out, the bottom part [G] of the tray pushes the bottom plate lift arm into the release slider.

11.5 PAPER END DETECTION

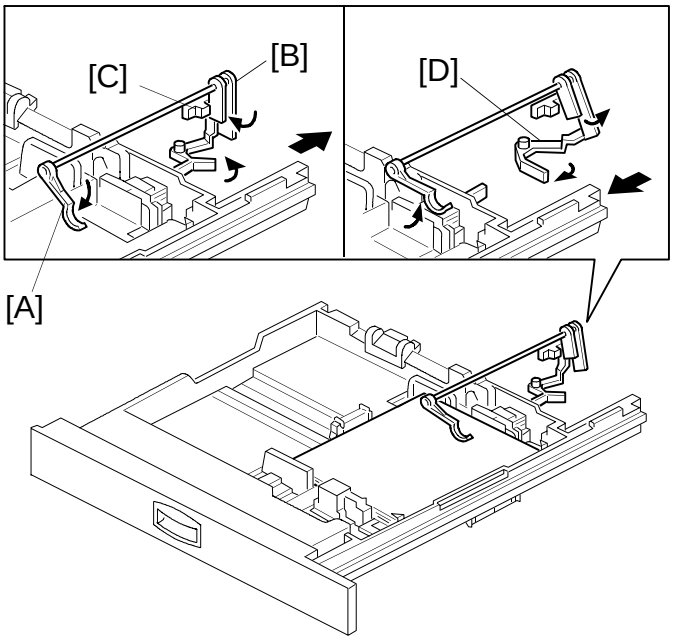


- A153/A155/A156 copiers -

If there is some paper in the paper tray, the paper end feeler [A] is raised by the paper stack and paper end sensor [B] is deactivated.

When the paper tray runs out of paper, the paper end feeler drops into the cutout [C] in the tray bottom plate and the paper end sensor is activated.

When a paper end condition occurs, the tray lift motor lowers the paper bottom plate and the pick-up solenoid turns off.

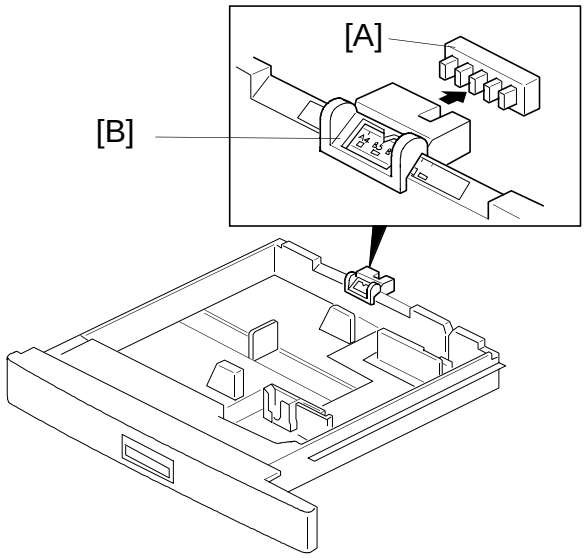


- A157/A159/A160 copiers -

The paper end feeler [A] is on the same shaft as the paper end actuator [B]. When the tray runs out of paper, the paper end feeler drops into the cutout in the tray bottom plate and the paper end actuator activates the paper end sensor [C].

The paper end actuator is in contact with the lever [D]. When the paper tray is drawn out of the copier, the lever turns as shown by the arrow in the diagram, and pushes up the actuator. As a result, the feeler rotates upwards. This mechanism is necessary to prevent the feeler from getting damaged by the paper tray body.

11.6 PAPER SIZE DETECTION

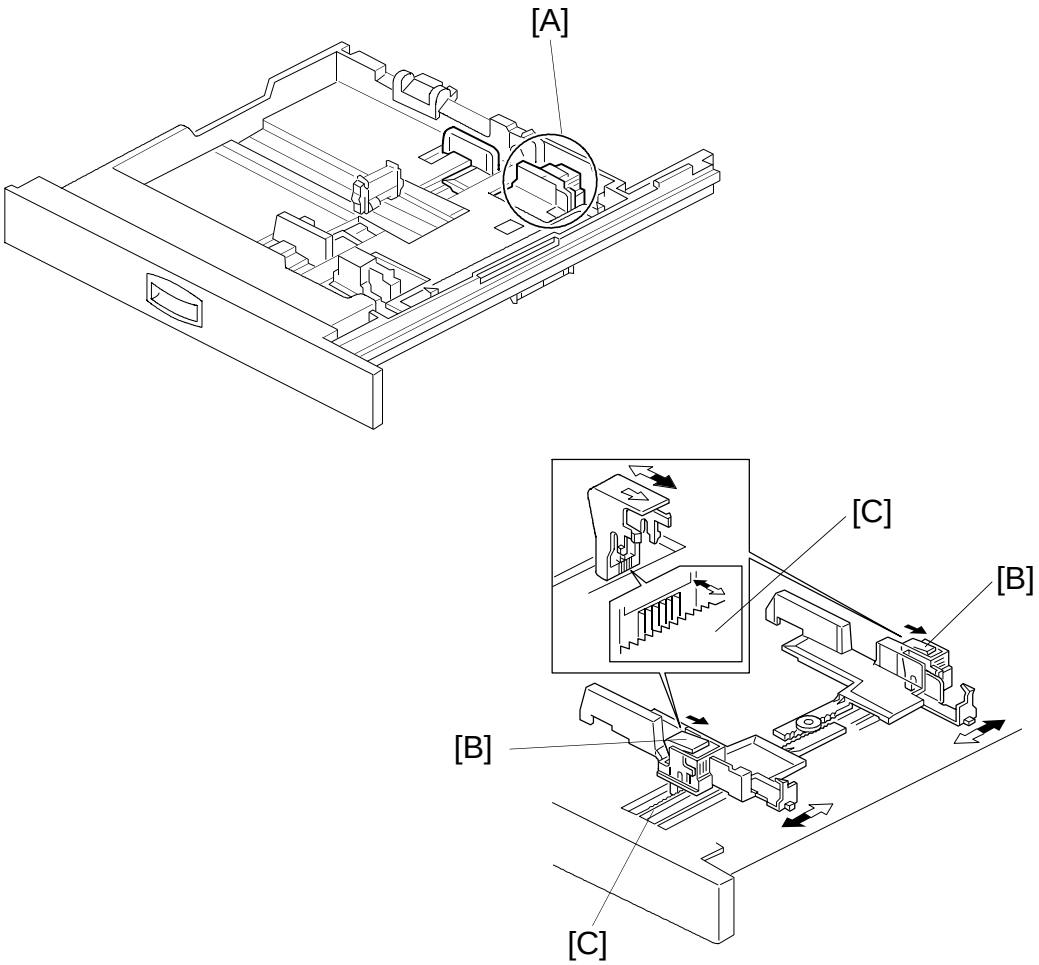


Actuated = 0 Deactuated = 1 1 2 3 4 5	**Paper size**	**L: Lengthwise** **S: Sideways**
	A4/A3 Version	**LT/DLT Version**
01111	A3-L	11" x 17"
00111	B4-L	8 1/2" x 14"
10011	A4-L	8 1/2" x 11"
01001	A4-S	11" x 8 1/2"
00100	B5-L	A4-L
00010	B5-S	A4-S
00001	A5-S	8 1/2" x 5 1/2"
10000	8 1/2" x 11"	11" x 15"
11000	11" x 8 1/2"	10" x 14"
11100	11" x 17"	8 1/2" x 13"
11110	F4-L	8" x 10"

The paper size switch [A] detects the paper size. The paper size switch has five microswitches inside. The paper size switches are actuated by an actuator plate [B] located on the rear of the tray. The actuator is slid across to match the paper size. Each paper size has its own unique combination of switch states, as shown in the table. The CPU determines the paper size by the signal combination from the switch assembly.

Using SP5-019, the first tray can be set up to accommodate one of a wider range of paper sizes. If this is done, the readings from the first tray's switch assembly are ignored. If a different size paper is used without changing SP5-019, paper jams will result.

11.7 SIDE FENCE DOUBLE STOPPER MECHANISM [A157/A159/A160]



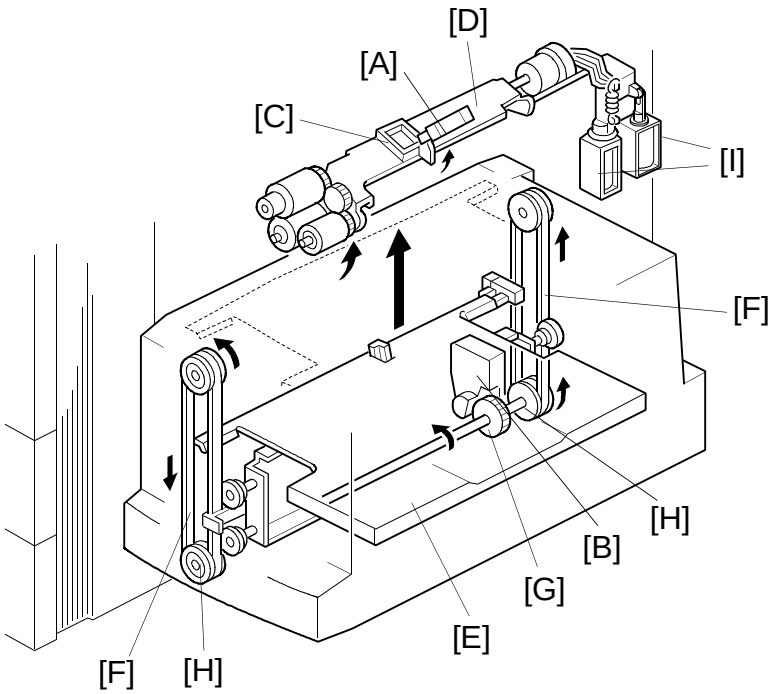
In this model, there is a side fence stopper mechanism for both the front and rear side fences.

If the tray is closed with excessive force after loading paper, paper may come over the rear side fence, because the fence is deformed by the weight of the paper leaning against it. As a result, skewing or paper jams may occur. To prevent this, a side fence stopper mechanism [A] has been added to the rear side fence also.

The release levers [B] have a stopper which contains teeth like those on a gear. The guide rails [C] also have teeth. When the release lever is pushed, the gear teeth release each other and the side fences can be moved.

11.8 LARGE CAPACITY TRAY

11.8.1 Paper Lift Mechanism



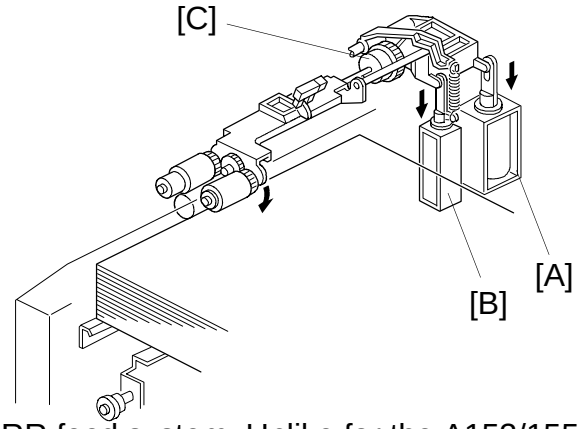
The LCT upper limit sensor [A] above the paper feed upper guide plate controls the LCT lift motor [B]. The actuator [C] for the sensor is on the pick-up roller bracket [D]. The LCT lift motor drives the LCT bottom plate [E] which is attached to the timing belts [F] through the helical gear [G], drive pulleys [H], and a timing belt.

When the LCT top cover is closed, the LCT cover switch actuates and both pick-up solenoids [I] are energized. The pick-up roller bracket then lowers and the LCT upper limit sensor is deactivated. At this time, the LCT lift motor starts rotating and the LCT bottom plate starts lifting.

When the top sheet of the paper stack raises the pick-up roller, the LCT upper limit sensor is activated and the LCT lift motor stops. Shortly after, the pick-up solenoids turn off and the pick-up roller goes back to the up position.

During the copy cycle, the pick-up roller is lowered to prepare for feeding the next sheet of paper. When the level of the paper stack has fallen, the LCT upper limit sensor becomes deactivated and the LCT lift motor turns on to maintain the correct level for paper feed.

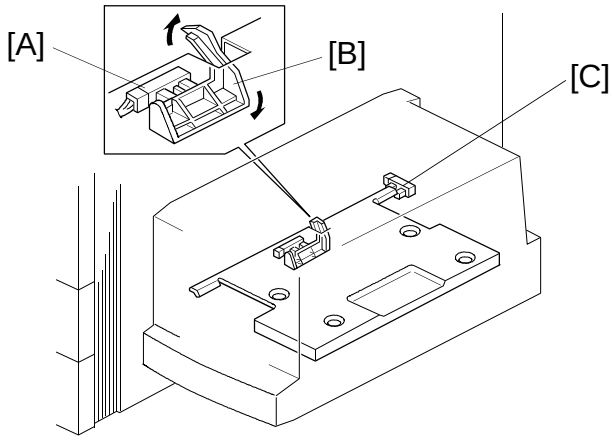
11.8.2 Paper Feed Mechanism



The LCT uses an FRR feed system. Unlike for the A153/155/156 paper trays, the feed and separation rollers are always in contact. The LCT pick-up solenoid [A], by-pass pick-up solenoid [B], and by-pass feed clutch [C] control paper feed from the LCT. When the Start key is pressed, the by-pass pick-up solenoid turns on, and stays on until the copy run has finished. At 150 ms after the Start key is pressed, the LCT pick-up solenoid turns on. Then, 100 ms after this, the by-pass feed clutch turns on to feed the top sheet of paper. Between sheets of paper, solenoid [B] turns off, but solenoid [A] stays on.

In machines without an LCT, the LCT pick-up solenoid [A] is missing.

11.8.3 Paper End Detection

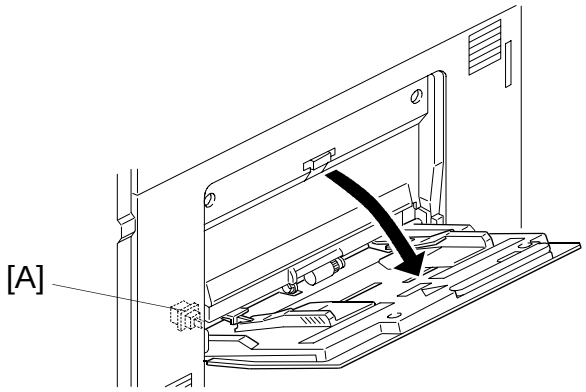


The LCT paper end sensor [A] is just under the LCT bottom plate.

When the LCT runs out of paper, the actuator [B] pivots into the LCT paper end sensor. Then the LCT lift motor starts to rotate in reverse to lower the LCT bottom plate. When the LCT lower limit sensor [C] is activated by the bottom plate, the LCT lift motor stops.

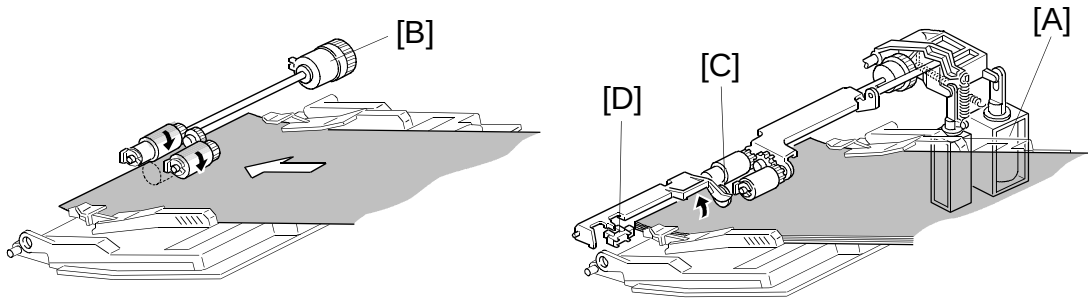
11.9 BY-PASS FEED TABLE

11.9.1 Table Open/Closed Detection



The by-pass feed table switch [A] detects when the by-pass feed table is opened. Then the CPU turns on the by-pass feed indicator on the operation panel.

11.9.2 Feed Mechanism/Paper End Detection



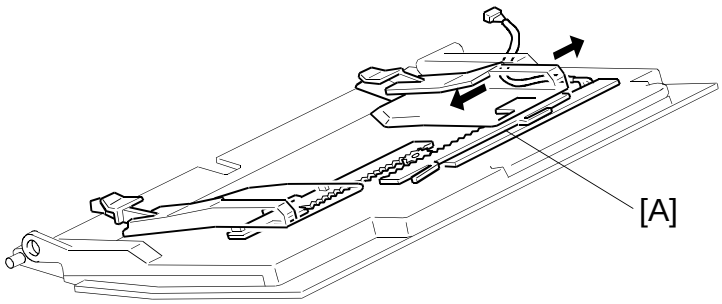
The by-pass feed table uses an FRR feed system, using the same rollers as the LCT, and one of the solenoids (solenoid [A]; also see LCT - Paper Feed Mechanism). Only one of the two solenoids in the mechanism is used, because the pick-up roller does not have to drop so far as it does when feeding from the LCT.

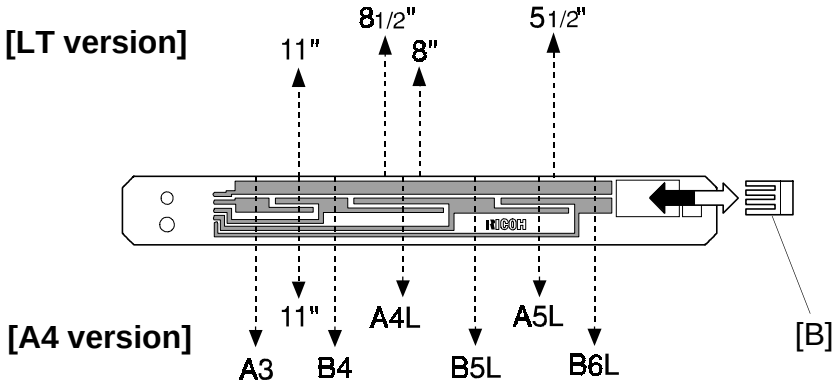
The user can put up to 40 sheets of paper on the by-pass feed table. Note that the paper can be pushed right into the machine, causing jams. The user must stop pushing the paper in when the by-pass feed indicator goes out.

When the Start key is pressed, the by-pass feed clutch [B] and the pick-up solenoid turn on to feed the top sheet of paper.

When there is no paper on the by-pass feed table, the paper end feeler [C] drops into the cutout in the lower guide plate and the by-pass feed paper end sensor [D] is deactivated.

11.9.3 By-pass Feed Paper Width Detection

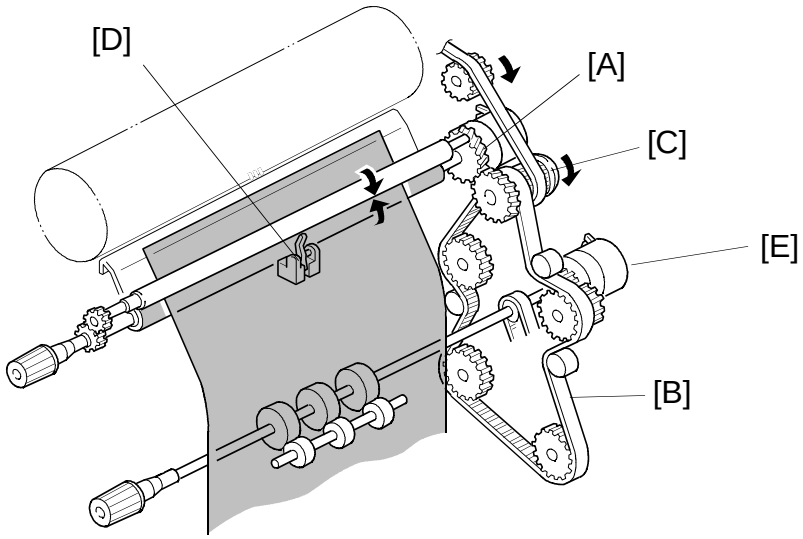




The by-pass feed paper width sensor board [A] monitors the paper width. The rear side fence is connected to the terminal plate [B]. When the side fences are positioned to match the paper width, the terminal plate slides along the wiring patterns on the detection board. The patterns for each paper width on the paper width detection board are unique. Therefore, the machine determines which paper width has been placed in the by-pass feed table by the signal output from the board.

For users with LT version models who wish to use A4 version paper sizes, or the other way round, the paper size from the by-pass feed tray can be fixed with SP5-019. The reading from the sensor will be ignored if this SP mode is used to select an exotic paper size. However, if the user attempts to use a size of paper that is different from that agreed with the technician for this setting, a paper jam will occur.

11.10 PAPER REGISTRATION



Main motor rotation is transmitted to the registration clutch [A] (located on the lower registration roller shaft) through the timing belt [B] and the relay gear [C].

The registration sensor [D] is positioned just before the registration rollers.

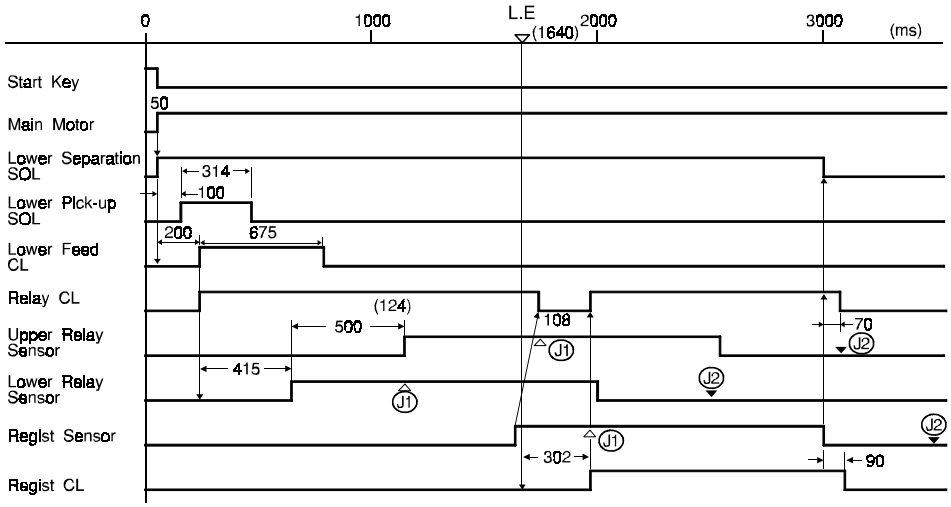
When the paper leading edge activates the registration sensor, the registration clutch turns off and the registration rollers stop turning. After the registration clutch turns off, the relay clutch [E] stays on for an extra 108 ms. This delay allows time for the paper to press against the registration rollers and buckle slightly to correct skew. The registration clutch energizes and the relay clutch re-energizes at the proper time to align the paper with the image on the drum. The registration and relay rollers feed the paper to the image transfer section.

The registration sensor is also used for paper misfeed detection.

11.11 PAPER FEED AND MISFEED DETECTION TIMING

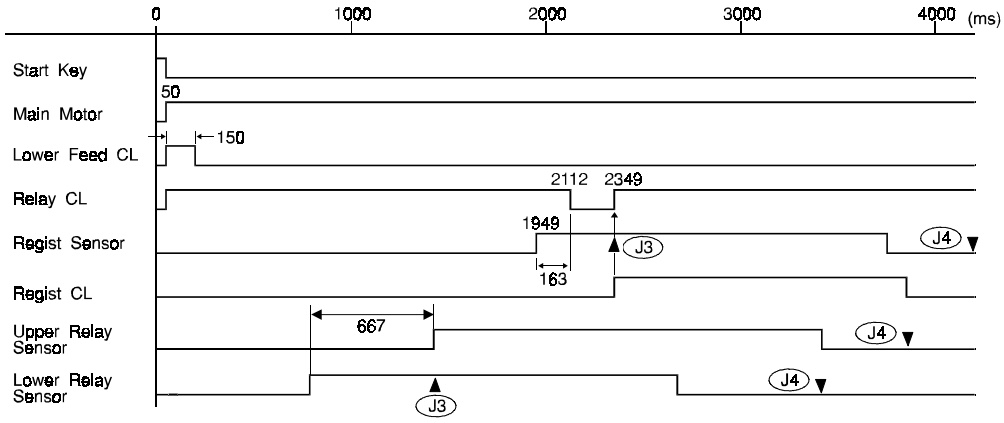
11.11.1 Paper Feed Tray

A153/A155/A156 copiers (A4 sideways)



L.E. (Leading Edge): Start Time for Scanning the Original

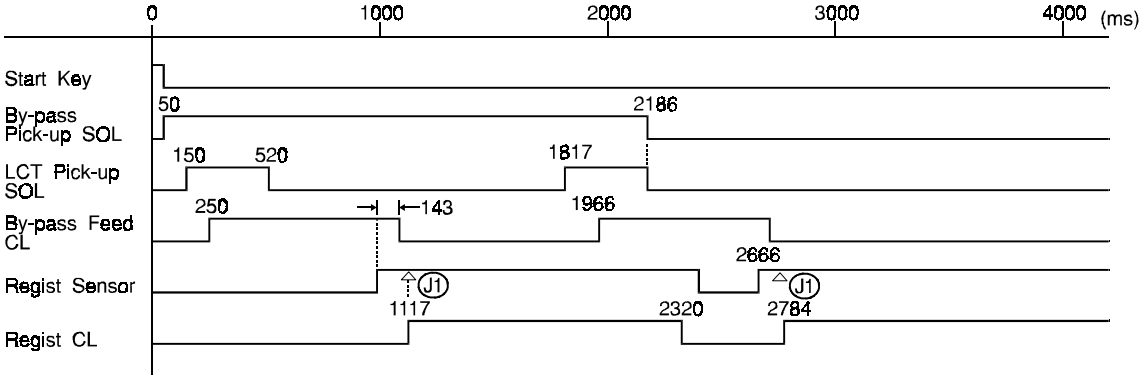
A157/A159/A160 copiers (A4 sideways)



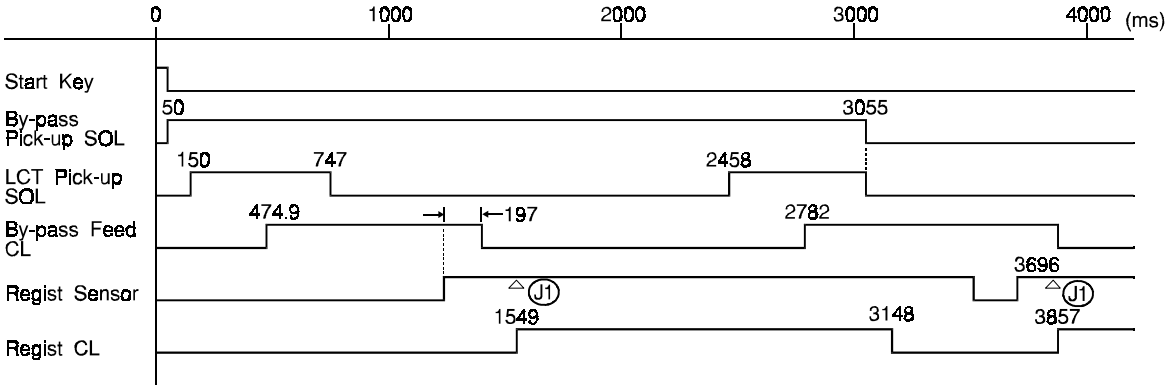
J1 and J2: Checks whether the sensors (relay sensors and registration sensor) are activated within 500 ms after the designated time for these sensors.

J3 and J4: Checks whether the sensors (relay sensors and registration sensor) are activated within 667 ms after the designated time for these sensors.

A155/A156 copiers (A4 sideways; two copies of a single-page original)



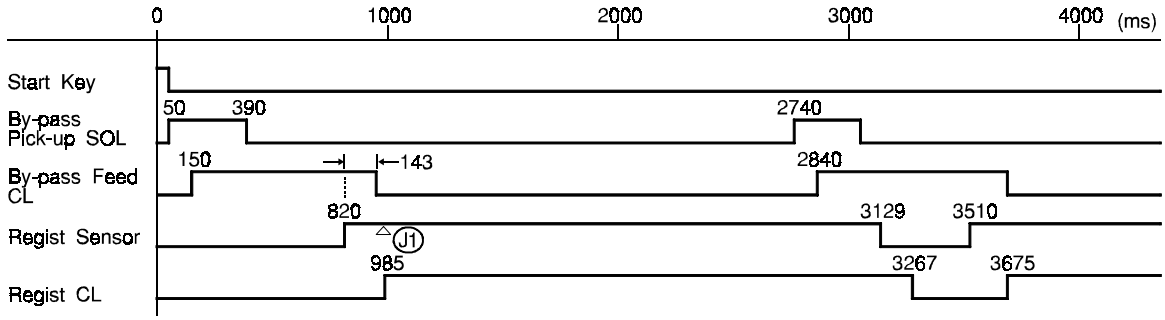
A159/A160 copiers (A4 sideways; two copies of a single-page original)



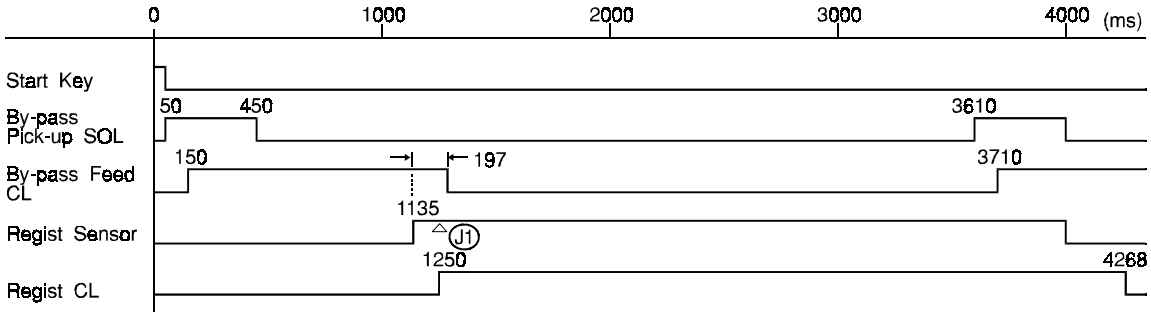
J1: Checks whether the registration sensor is activated when the registration clutch is turned on.

11.11.2 By-pass Feed

A153/A155/A156 copiers (A4 sideways)



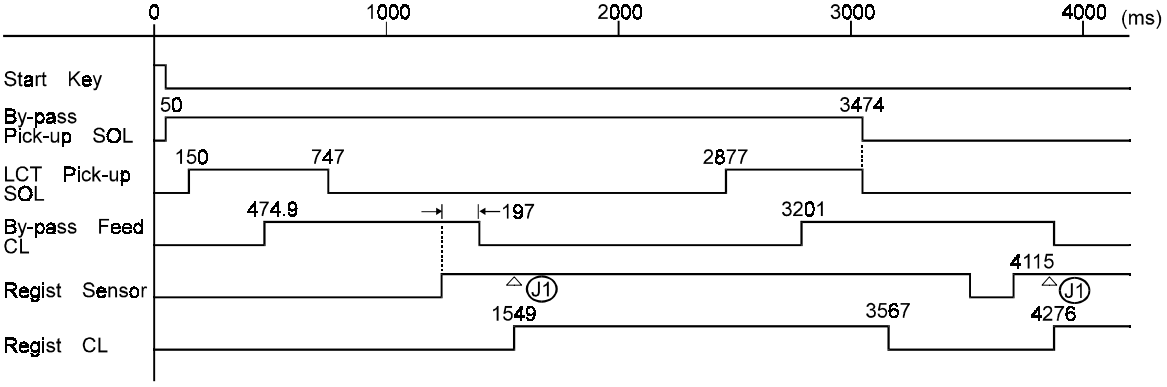
A157/A159/A160 copiers (A4 sideways)



J1: Checks whether the registration sensor is activated when the registration clutch is turned on.

11.11.3 (A160/A157) Copier

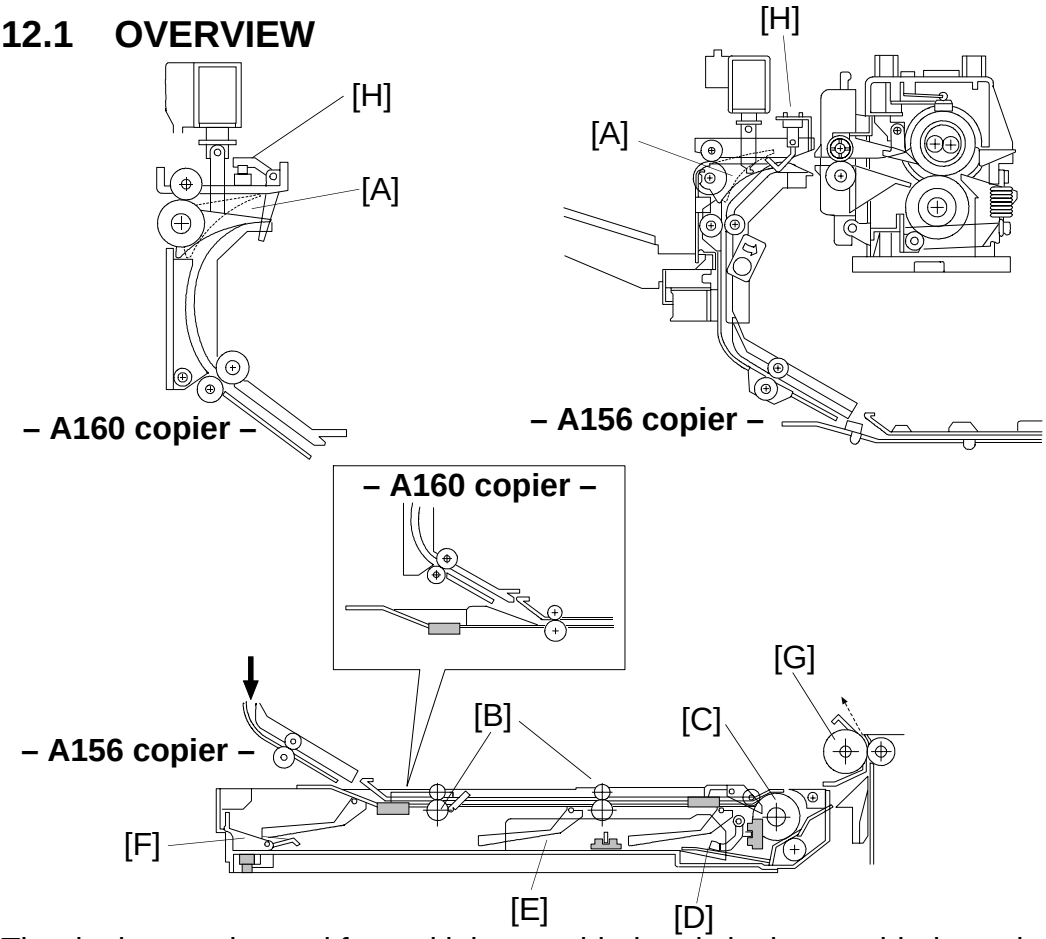
(A4 sideways; two copies of a single-page original)



J1: Checks whether the registration sensor is activated when the registration clutch is turned on.

12. DUPLEX

12.1 OVERVIEW



The duplex tray is used for multiple two-sided and single two-sided copying. Note the paper feed path differences between the A156 and the A160. Timing of the duplex function is started when the paper actuates the fusing exit sensor [H].

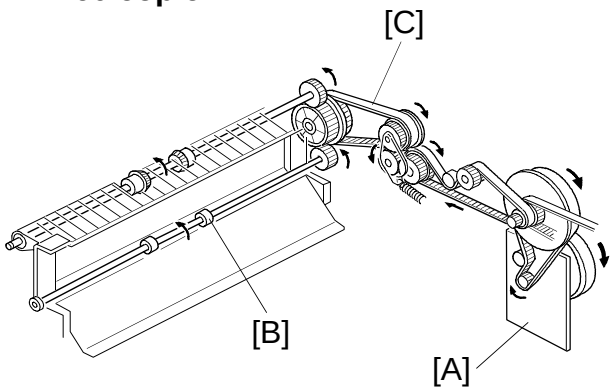
The junction gate [A] rotates up 1.1 seconds after the registration clutch has turned on, and the copy passes to the duplex tray. Shortly after the fusing exit sensor [H] detects the leading edge of the paper, the entrance rollers [B] and duplex feed roller [C] start to rotate. At the same time, the duplex bottom plate [D] lowers.

The copy feeds over the duplex feed roller and into the tray. The jogger fences [E] and end fence [F] move inward to square the copy stack, then they move back 10.5 mm from the paper stack. After the final copy is delivered to the stack area, the jogger and end fences remain against the paper stack.

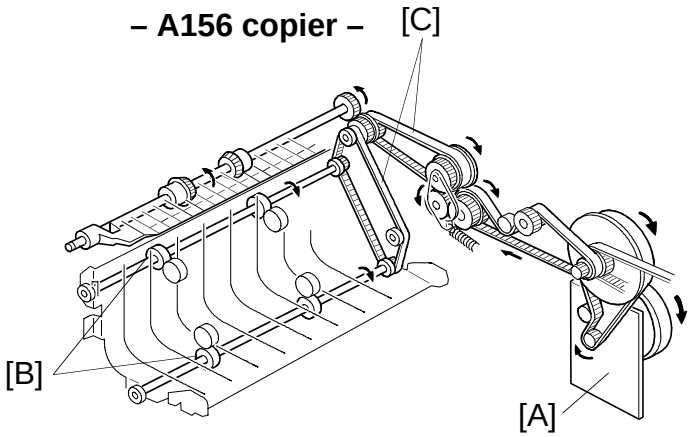
After the final copy is squared the second side copy is initiated. The duplex bottom plate lifts the paper to the feed position and the duplex feed roller starts rotating counterclockwise to feed the top copy to the relay rollers [G]. The second side is then copied with the copy following the upper paper tray feed station paper path.

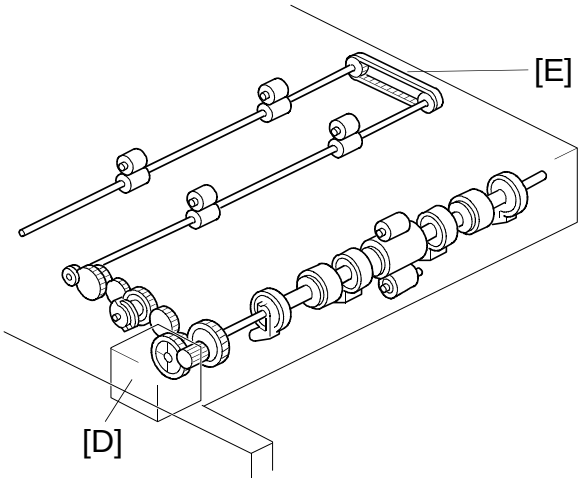
12.2 DRIVE MECHANISM

– A160 copier –



– A156 copier –

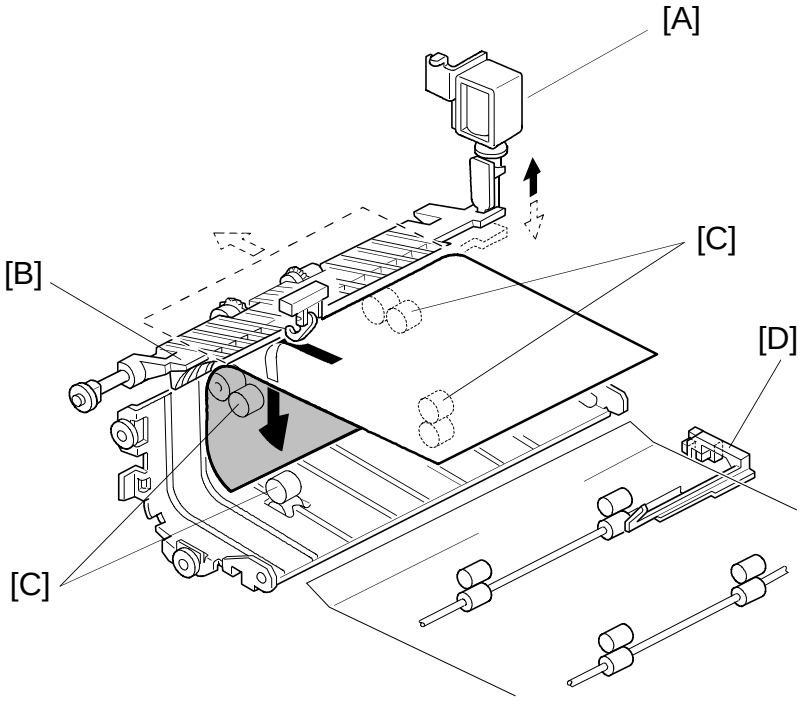




The main motor [A] drives the transport rollers [B] through the timing belts [C]. All rollers in the duplex tray are driven by the duplex feed motor [D] through a series of gears and a timing belt [E]. Helical gears are used to reduce noise.

The duplex feed motor also drives the duplex bottom plate up and down.

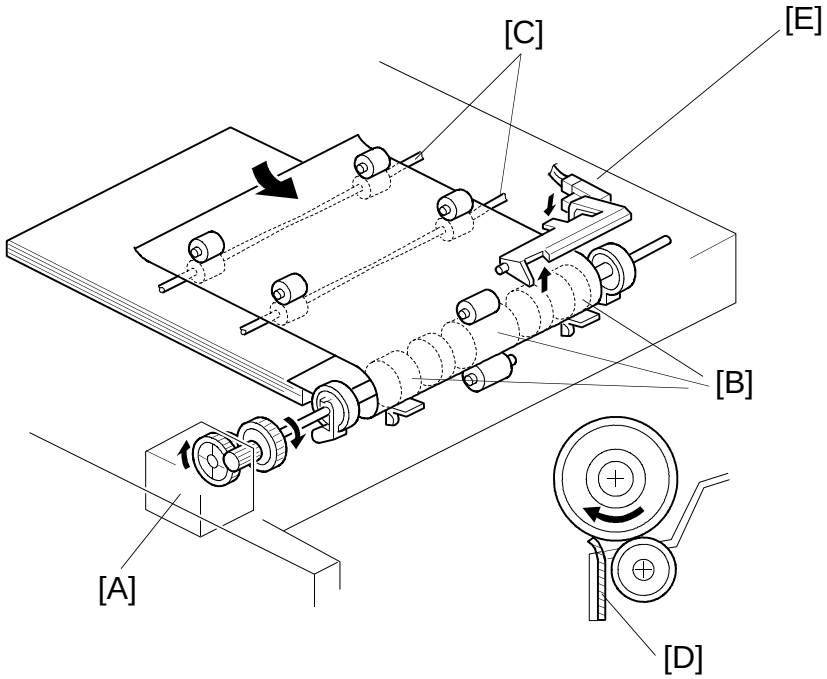
12.3 TURN GUIDE SECTION



The junction gate solenoid [A] is energized 1.1 seconds after the registration clutch has been turned on. Then, the junction gate [B] rotates upwards to direct the copy paper to the duplex turn guide section. The junction gate solenoid stays on until the first side copies are stacked in the duplex tray.

The copy is then directed to the duplex entrance guide by the transport rollers [C]. There is a duplex entrance sensor [D] for paper misfeed detection.

12.4 DUPLEX ENTRANCE TO DUPLEX TRAY

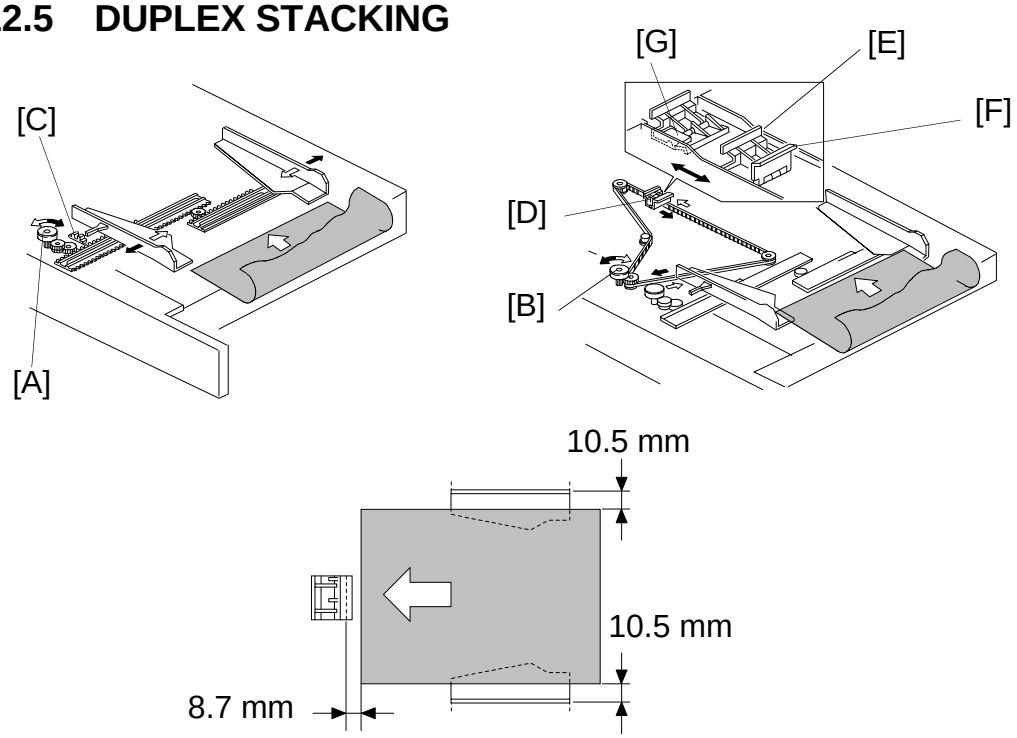


The duplex feed motor [A] starts turning 500 ms after the leading edge of the paper activates the fusing exit sensor. This motor drives the duplex feed rollers [B] and the duplex entrance rollers [C]. The copy paper from the turn guide section is directed to the duplex tray through these rollers.

The tip of the flip mylar [D] moves to the left (front view) when the duplex feed rollers rotate to feed the copy into the duplex tray. The mylar presses the copy against the duplex feed rollers, ensuring that the trailing edge of the copy clears the guide plate.

The duplex turn sensor [E] detects the trailing edge of the paper as it enters the tray.

12.5 DUPLEX STACKING



There are two motors for driving the fences. The side jogger fences are driven by the side fence jogger motor [A]. The end jogger fence is driven by the end fence jogger motor [B]. Using two separate motors for the side and end fences allows the duplex tray to handle all paper sizes from A3/11" x 17" to A5/ 8$^{1}/_{2}$" x 5$^{1}/_{2}$" sideways.

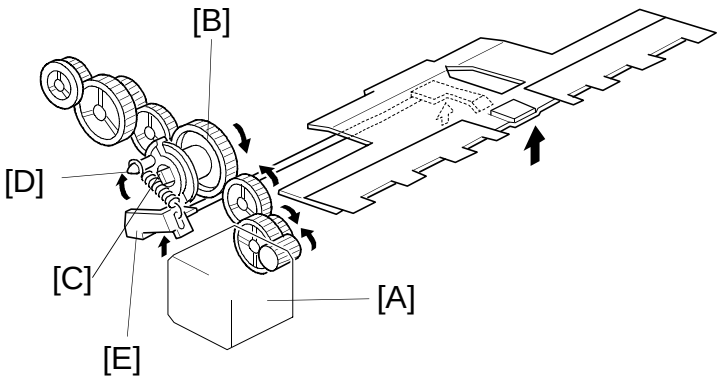
There are two home position sensors. One is for the jogger fences [C], and the other is for the end fence [D]. When the main switch turns on, the side fence jogger motor and the end fence jogger motor rotate to place the jogger fences and the end fence at their home positions.

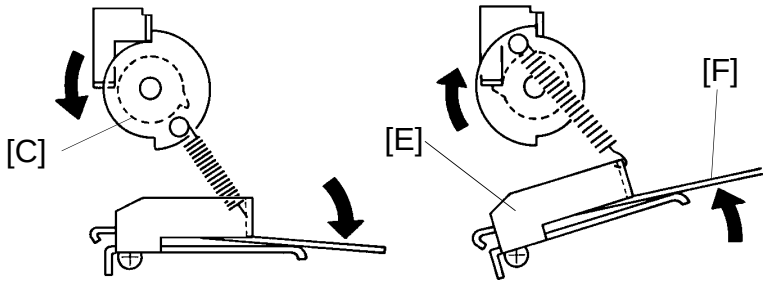
When the registration clutch turns on, the side fences move 10.5 mm, and the end fence moves 8.7 mm away from the selected paper size. Then, when the copy paper is delivered to the duplex tray, the jogger fences move inward to square the paper. (This is done 690 ms [A156] or 920 ms [A160] after the duplex turn sensor detects the trailing edge of copy paper. The duplex turn sensor is [E] in the diagram on the previous page) Shortly after this, the jogger fences move back to their previous positions. After the last copy of the first side copy run enters the duplex tray, the jogger fences remain against the paper stack.

There are two end fences. One [E] is for A3/11 x 17" size paper. The other [F] is for sizes smaller than B4. They are included as a unit. When A3/11 x 17" size paper is in the duplex tray, the end fence unit moves to the left and the B4 end fence rotates down as it is pressed against the end fence stopper [G].

12.6 PAPER FEED FROM THE DUPLEX TRAY

12.6.1 Tray Lift Mechanism





- While copying the first side - - While lifting the tray -

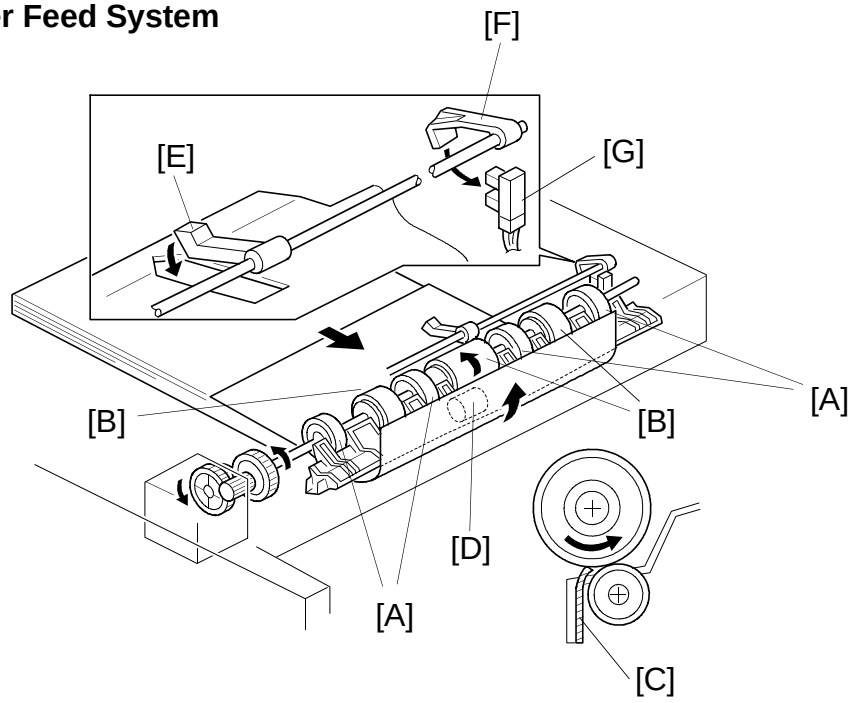
After the first side copies have been made, the duplex feed motor [A] changes direction, and the cam clutch gear [B] lifts up the duplex bottom plate through a series of gears.

While the first side is being copied, the duplex feed motor is rotating clockwise and the cam clutch gear is rotating counter clockwise (see the above drawing).

When all copies have been stacked in the duplex tray, the duplex feed motor rotates counterclockwise, and the cam clutch gear rotates clockwise. The cam clutch [C] also rotates clockwise because of the spring inside the clutch. The pin [D] on the clutch lifts up the duplex lift lever [E] through a spring, raising the duplex bottom plate [F].

When the duplex feed motor rotates clockwise again, the cam clutch rotates counterclockwise, and the bottom plate lowers.

12.6.2 Paper Feed System



While paper is being stacked in the duplex tray, the paper flatteners [A] correct curl at the leading edge of the paper.

After all the paper has been stacked in the duplex tray, the jogger fences square the paper stack and the duplex feed motor rotates counterclockwise briefly to prepare to feed the paper from the duplex tray. At this time, the bottom plate rises and the duplex feed rollers [B] move the flip mylars [C] back to the right (front view).

The duplex paper feed system consists of three sets of duplex feed rollers and a friction roller [D]. As the friction roller has a one-way bearing inside, it rotates freely during paper stacking and locks during paper feeding. The duplex feed rollers can feed only the top sheet of the stack because the friction rollers function in the same way as a friction pad does.

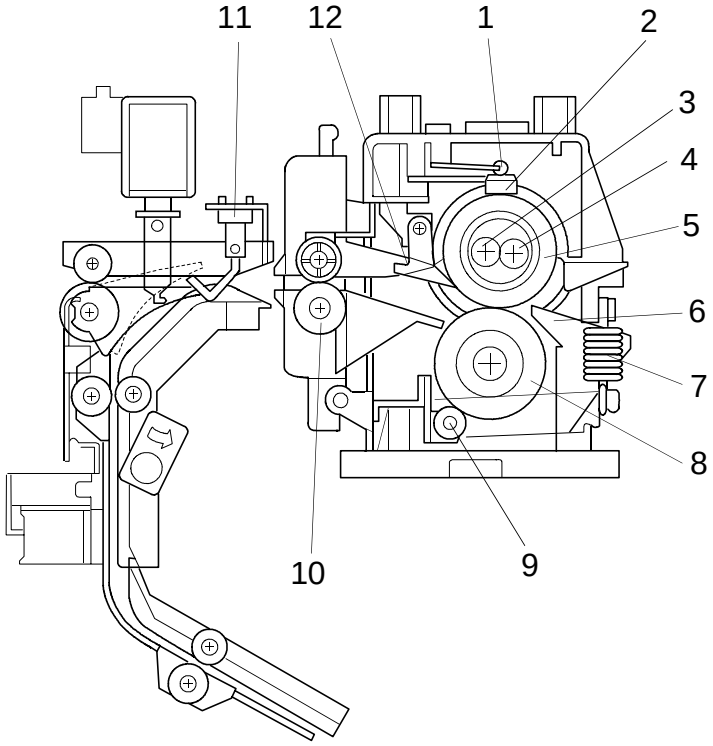
After that, the second side copies follow the upper paper tray feed station paper path.

After the duplex tray feeds out the final copy, the paper end feeler [E] drops through a slot in the duplex bottom plate. The duplex paper end actuator [F], which is on the same shaft as the duplex paper end feeler, pivots into the duplex paper end sensor [G]. The sensor sends the signal to the CPU to stop the next paper feed cycle.

For a diagram of the paper feed path, see "Paper Path - Duplex Copying" in the Overall Machine Information section.

13. IMAGE FUSING

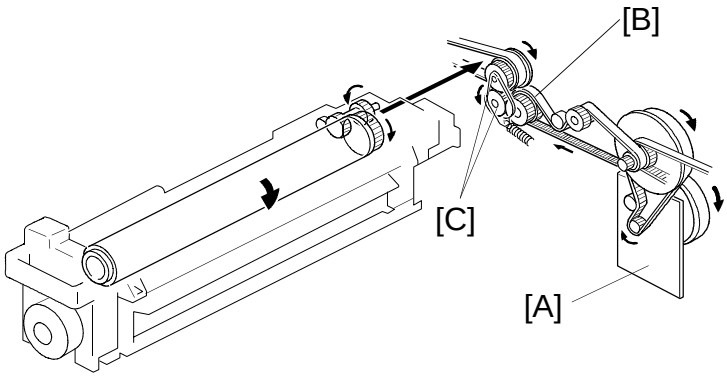
13.1 OVERVIEW

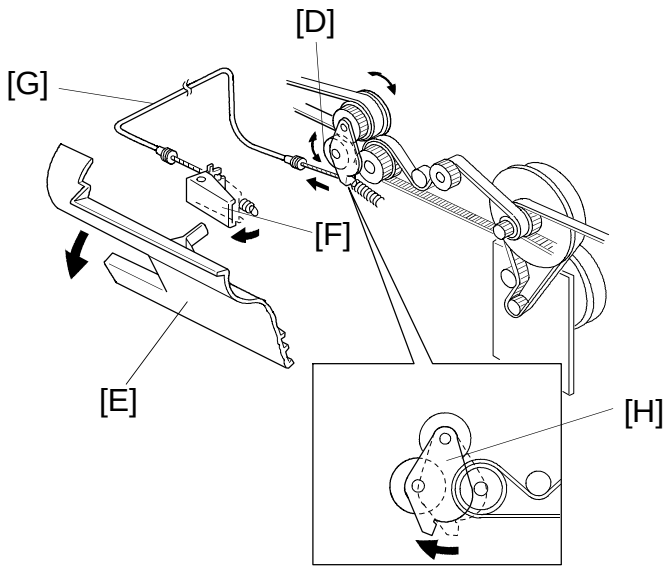


The fusing unit consists of the following parts:

1. Thermofuses (2 pcs)
2. Thermistors (2 pcs)
3. Secondary fusing lamp
4. Main fusing lamp
5. Hot roller
6. Lower entrance guide
7. Pressure springs
8. Pressure roller
9. Cleaning roller
10. Fusing exit roller
11. Fusing exit sensor
12. Hot roller strippers

13.2 FUSING DRIVE AND RELEASE MECHANISM



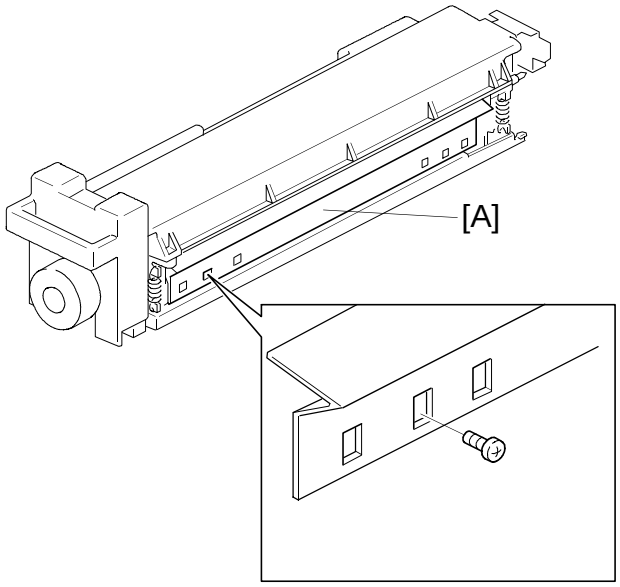


The main motor [A] drives the fusing unit through a timing belt [B] and some gears [C].

The fusing unit drive release mechanism automatically disengages the fusing unit drive gear [D] when the front cover [E] is opened. This allows the fusing unit drive gear to rotate freely so that misfed paper can be easily removed.

When the front cover is opened, the actuator plate [F] pulls release wire [G]. The wire pulls the fusing unit gear bracket [H] and the fusing unit drive is disengaged.

13.3 FUSING ENTRANCE GUIDE SHIFT MECHANISM



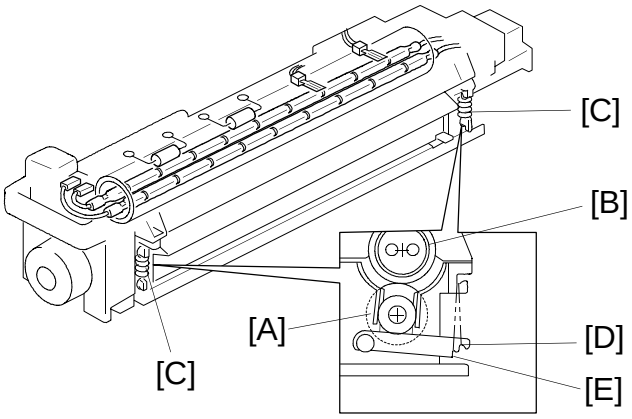
The entrance guide [A] for this machine is adjustable for thick or thin paper.

For thin paper, move the entrance guide up (this is the standard position). This slightly lengthens the paper path which prevents the paper from creasing in the fusing unit.

For thick paper, move the entrance guide down. This is because thick paper does not bend as easily, and is therefore less prone to creasing. Also, the lower setting allows more direct access to the gap between the hot and pressure rollers. This prevents thick paper from buckling against the hot roller, which can cause blurring at the leading edge of the copy.

There are three screw holes on each side for securing the entrance guide. Normally, the center screw hole on each side is used. The other screw holes are spare in case the center holes get damaged.

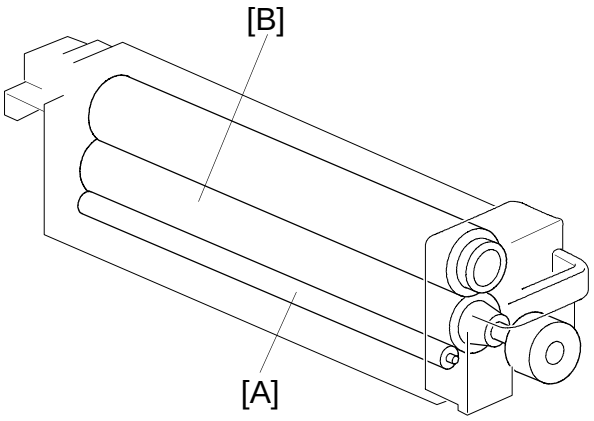
13.4 PRESSURE ROLLER



The pressure roller [A] is made of silicone rubber with a teflon tube coating. The pressure springs [C] constantly apply pressure between the hot roller [B] and the pressure roller.

The pressure can be changed by adjusting the position of the pressure springs. The upper position [D] is the normal setting. The lower position [E] increases the pressure and this prevents insufficient fusing by the fusing unit.

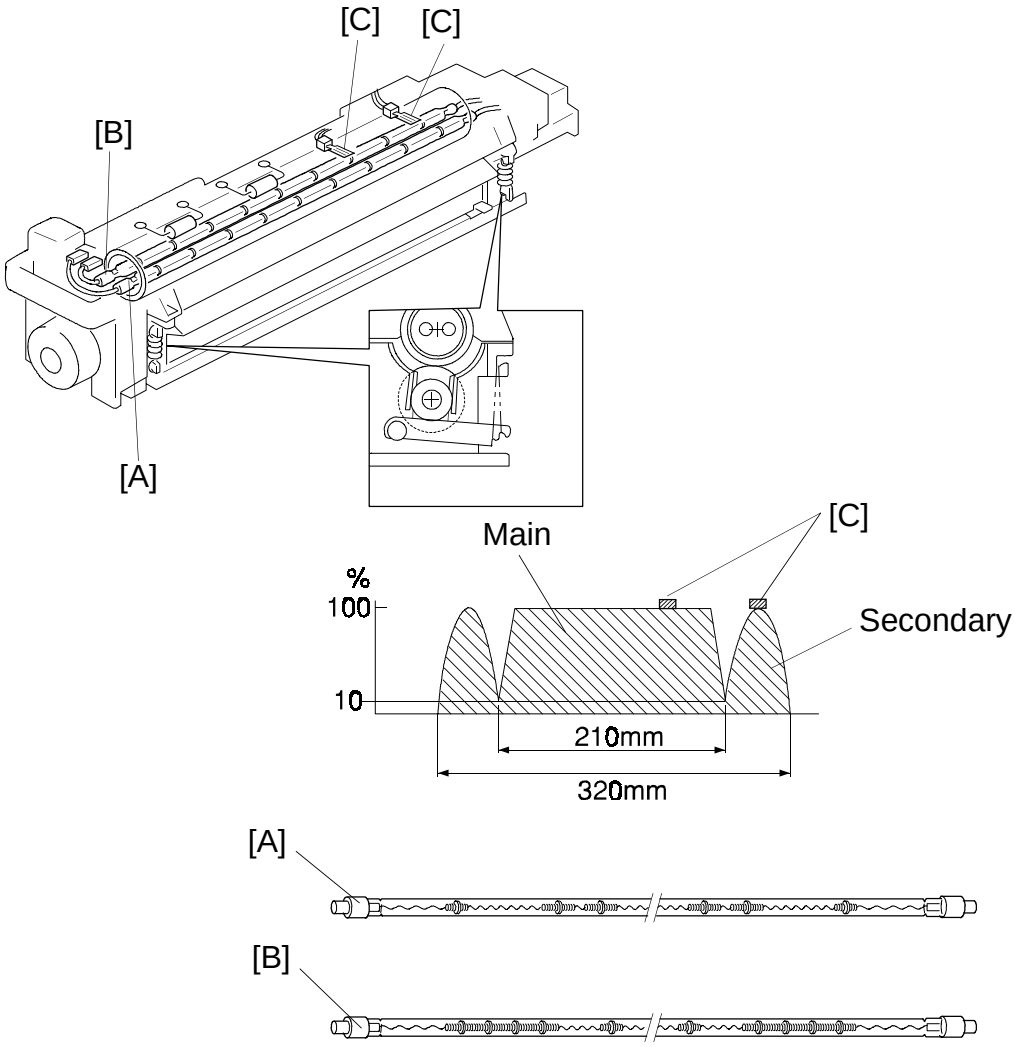
13.5 CLEANING MECHANISM



The cleaning roller [A] is always in contact with the pressure roller [B]. It collects toner and paper dust adhering to the surface of the pressure roller.

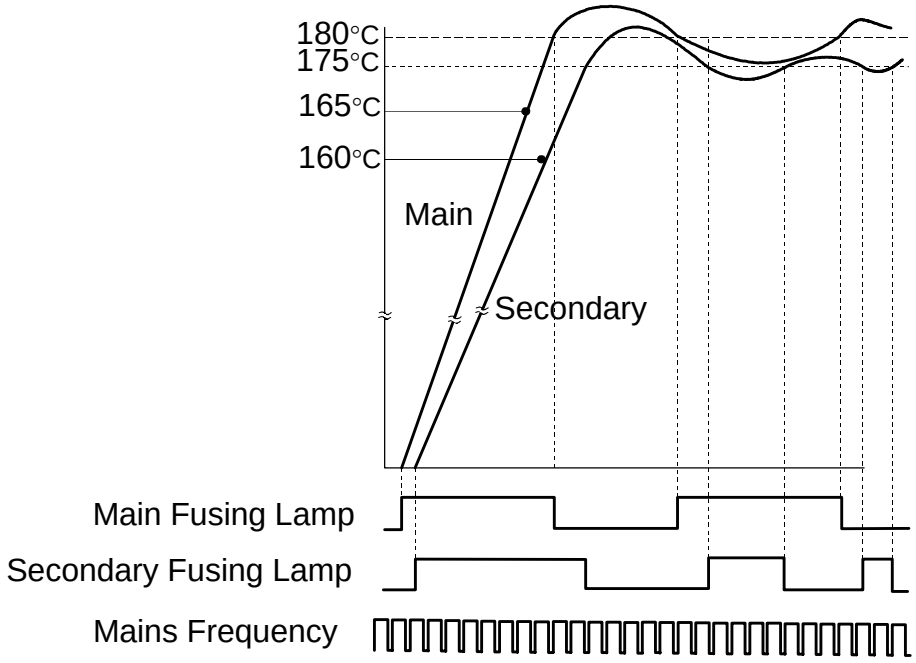
This is because the cleaning roller is made of metal and collects adhering matter more easily than the pressure roller (which has a teflon coating).

13.6 FUSING LAMP CONTROL



There are two fusing lamps in the hot roller: the main fusing lamp (550 W) [A] and the secondary fusing lamp (350 W) [B]. The positions of the filaments in the main and secondary fusing lamps are different. So, the main fusing lamp heats the center of the hot roller and the secondary fusing lamp heats both ends of the hot roller. Using this system, the temperature of the center and ends of the hot roller will be uniform.

The temperatures at the center and the side are monitored by individual thermistors [C]. Paper of various sizes will cause the hot roller to give up heat at different rates. The two thermistors detect this change and turn on the lamps accordingly.



– A153/A155/A156 copiers –

	Fusing Lamp	Standby Temp.	Operation Temp.
A153/A155/A156 copiers	Main	165°C	180°C
	Secondary	160°C	175°C
A157/A159/A160 copiers	Main	160°C	175°C
	Secondary	160°C	175°C

When the main switch turns on, the CPU checks the frequency of the A.C. line for 500 ms; this is done in case phase control mode is selected later. Then the CPU turns on the main fusing lamp. After 3 more seconds, the secondary fusing lamp is turned on. This delay reduces the surge current after the main switch is turned on.

When both thermistors detect the stand-by fusing temperature (see the above table), the copier starts fusing idling. If the fusing temperature was above 50°C when the main switch was turned on, the copier does not go into the fusing idle cycle.

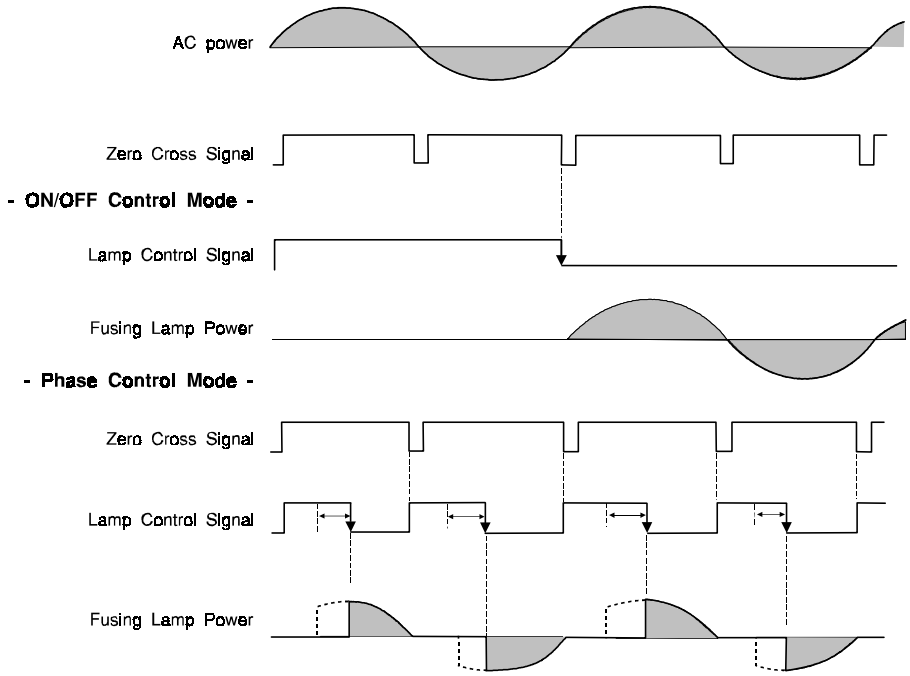
If the fusing lamps are turned on while the exposure lamp is on, the power supplied to the exposure lamp may fluctuate, possibly degrading the copy quality. To prevent this, in this machine, the fusing lamps can either stay off or change from on to off while the exposure lamp is on.

There are two types of fusing unit control: on/off control, and phase control. The mode can be selected with SP1-104.

- On/Off Control -

When both thermistors detect the operation temperature, both fusing lamps are turned off. After that, the CPU keeps the operation temperature constant by turning the lamps on and off. This is the default setting.

- Phase Control Mode -



In on/off control mode, the ac drive board supplies full ac power to the fusing lamps.

In phase control mode, the main board CPU controls the lamp control signal duty cycle which in turn affects the duty cycle of the mains supply.

Phase control only affects the main fusing lamp. The secondary lamp is always controlled using on/off control.

When the main switch is turned on, the main board starts to output the lamp control signal, which is generated from the zero cross signal.

The duty cycle of the lamp control signal depends on the temperature of the hot roller. When the hot roller temperature is low, the lamp control signal pulse will be wider, and the mains duty cycle will be wider. Conversely, if the roller temperature is high, the duty cycles will be smaller to reduce the temperature.

Phase control mode is selected only if the user has a problem with electrical noise on the same circuit or interference.

13.7 OVERHEAT PROTECTION

If the hot roller temperature stays higher than 230°C for 5 seconds, the CPU cuts off the power to the fusing lamps. At the same time, E-543 lights on the operation panel.

Even if the thermistor overheat protection fails, thermofuses are installed in series with the common ground line of the fusing lamps. If the temperature of either thermofuse reaches 169°C, the thermofuse opens, removing power from the fusing lamps. At the same time, the copier stops operating.

13.8 ENERGY SAVER FUNCTIONS

When the copier is not in use, the energy saver function reduces power consumption by decreasing the fusing temperature.

If the auto energy saver mode timer (SP5-102) runs out, the copier automatically enters energy saver mode. The fusing lamp switches off until the lamp reaches the temperature selected with SP1-105-002. The lower this temperature is, the longer the waiting time until the copier returns to the ready condition.

Also, when the Energy Saver/Clear Mode key is held down for over 1 s, the copier goes into the energy saver mode. The Energy Saver indicator turns on and all the other indicators turn off.

There is also an auto-off timer that can be programmed with SP5-305. If this timer expires, the machine cuts all power to the fusing unit.

The copier returns to the ready condition if someone stands at the front of the copier (in other words, when the Auto Response sensor is activated).

13.9 MAIN FUSING LAMP INTERCHANGEABILITY

The main fusing lamp for the FT4022/4522 (A161/A162) is different from that of the FT4027/4527 (A157/A160). The total span of all the filaments has been expanded for the FT4022/4522 (A161/A162) copier to compensate for the difference in the copies per minute and the warm-up time.

There is more overlap of the main and secondary fusing lamp filaments in the FT4022/4527 (A161/A162) compared with the FT4027/4527 (A157/A160) copier. This allows a faster heat up time around the edges of the hot roller.

To distinguish between the two types of lamp, the lamp connector color at the front side is different.

FT4022/4527 A161/A162 - Blue
FT4027/4527 A157/A160 - White

NOTE: If an FT4022/4522(A161/A162) lamp is installed in a FT4027/4527 (A157/A160) copier, faster warm-up may be achieved, but fusing problems may occur during multi-copy runs due to a lack of heat for the higher copy speed.

The secondary fusing lamp is the same as for the base copier.

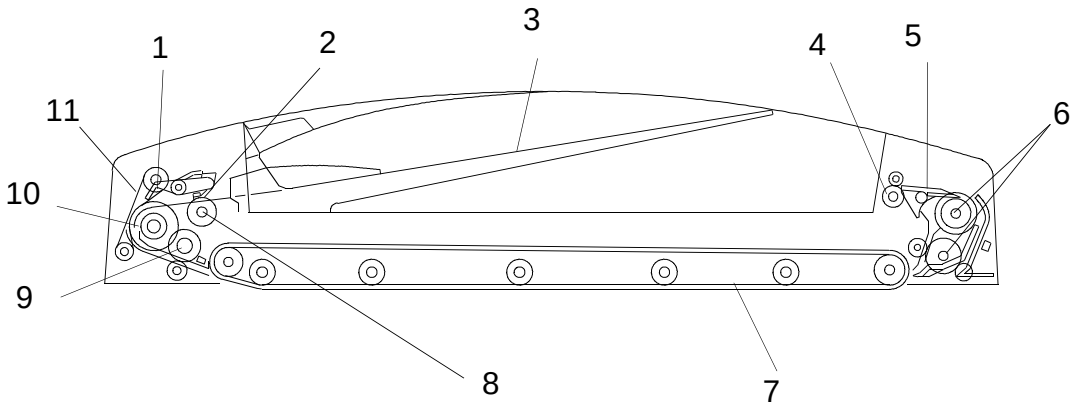
AUTO REVERSE DOCUMENT FEEDER A548

1. SPECIFICATIONS

Original Size and Weight:	Thick original mode (default mode) Use this setting for normal paper types Maximum A3, 11" x 17" Minimum B6 (sideways), 5 1/2" x 8 1/2" Weight 52 ~ 128 g/m^2 (14 ~ 34 lb) Thin original mode Maximum A3, 11" x 17" Minimum B6, 5 1/2" x 8 1/2" Weight 40 ~ 128 g/m^2 (11 ~ 34 lb) Auto reverse mode Maximum A3, 11" x 17" Minimum B5, 5 1/2" x 8 1/2" Weight 52 ~ 105 (14 ~ 27 lb)
Original Feed:	Automatic feed - ADF mode Manual feed one by one - SADF mode Auto Reverse Feed - ARDF mode
Original Table Capacity:	50 sheets at 80 g/m^2 (21 lb)
Original Placement:	Face up, first sheet on top
Original Separation:	Feed Roller and Friction Belt
Original Transport:	One flat belt
Power Consumption:	45 W
Power Source:	24 V $\pm$ 10% from the copier, 1.8 A
Dimensions (W x D x H):	610 x 507 x 130 mm (24.0" x 20.0" x 5.1")
Weight:	Approximately 10.5 kg (23.2 lb)

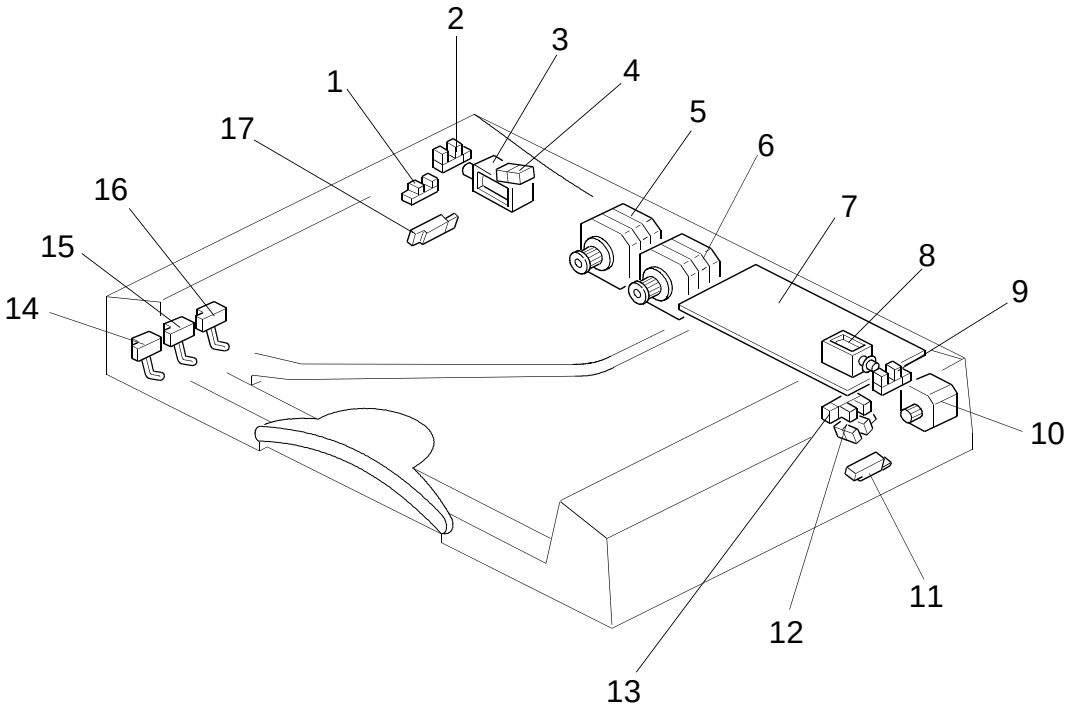
2. COMPONENT LAYOUT

2.1 MECHANICAL COMPONENTS



1. Original Stopper
2. Press Lever
3. Original Table
4. Exit Rollers
5. Inverter Pawls
6. Inverter Rollers
7. Transport Belt
8. Pick-up Rollers
9. Pull-out Roller
10. Feed Roller
11. Friction Belt

2.2 ELECTRICAL COMPONENTS



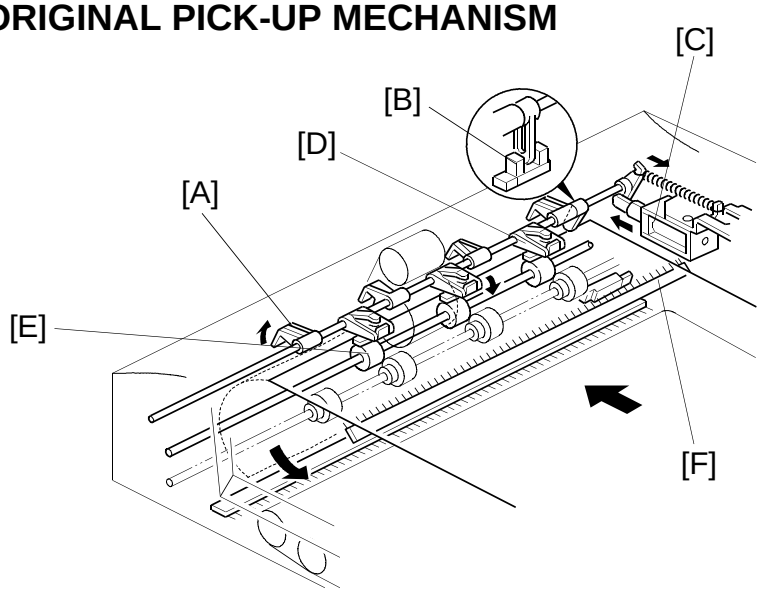
1. Original Set Sensor
2. Feed-in Cover Open Sensor
3. Stopper Solenoid
4. Indicator Panel Lamps
5. Feed-in Motor
6. Belt Drive Motor
7. DF Main Board
8. Inverter Solenoid
9. Feed-out Cover Open Sensor
10 Feed-out Motor
11. Feed-out Sensor
12. APS Start Sensor
13. DF Position Sensor
14. Original Width Sensor - 1
15. Original Width Sensor - 2
16. Original Width Sensor - 3
17. Registration Sensor

3. ELECTRICAL COMPONENT DESCRIPTION

Symbol	Name	Function	Index No.
Motors			
M1	Feed-in	Drives the feed-in system (pick-up, feed and pull-out rollers, separation belt)	5
M2	Belt Drive	Drives the transport belt	6
M3	Feed-out	Drives the feed-out and the inverter system	10
Sensors			
S1	Original Set	Detects whether originals have been placed on the original table	1
S2	Feed-in Cover Open	Informs whether the feed-in cover is open or not	2
S3	Feed-out Cover Open	Informs whether the feed-out cover is open or not	9
S4	Feed-out	Checks for original misfeeds and determines original stop timing when in auto-reverse mode	11
S5	APS Start	Informs the CPU that it is time to detect the original size (in platen mode)	12
S6	DF Position	Informs the CPU whether the DF is in the up or down position	13
S7	Original Width-1	Detects the width of the original	14
S8	Original Width-2	Detects the width of the original	15
S9	Original Width-3	Detects the width of the original	16
S10	Registration	Determines original stop timing and measures the length of the original	17
Solenoids			
SOL1	Stopper	Lifts the original stopper and lowers the feed-in lever to feed the set of originals to the feed roller	3
SOL2	Inverter	Energizes to invert the original when copying two-sided originals	8
PCB			
PCB1	DF Main Board	Controls all DF functions	7
Indicators (Lamps)			
L1	Ready	Informs the operator that the DF is in the down position.	4
L2	Auto	Informs the operator that the auto feed mode is available.	4

4. DETAILED DESCRIPTIONS

4.1 ORIGINAL PICK-UP MECHANISM

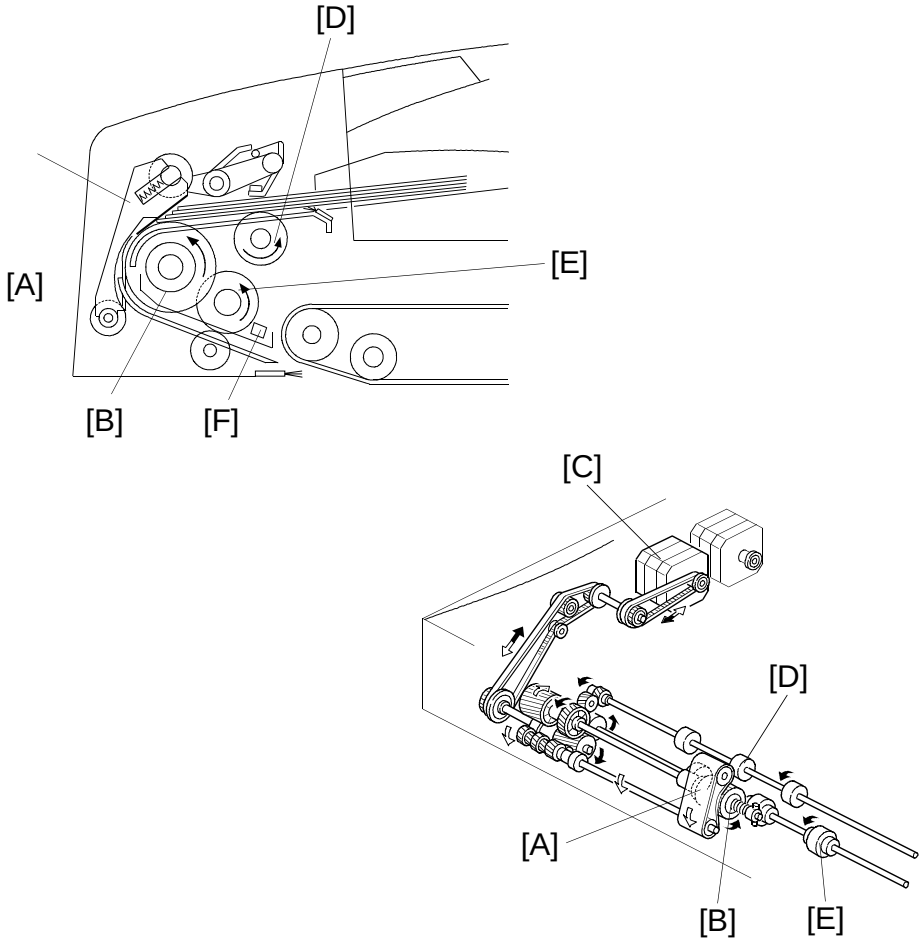


When an original is placed on the table, the leading edge is stopped by the stopper [A], and the feeler activates the original set sensor [B]. The Insert Original indicator light goes out and the DF informs the copier's CPU that the originals have been set.

When the Print key is pressed, the stopper solenoid [C] activates to raise the stopper to allow the originals to be fed in, and to lower the press lever [D] to press the originals against the pick-up rollers [E].

An anti-static brush [F] is installed to eliminate static electricity caused during the original pick-up process.

4.2 SEPARATION AND PAPER FEED MECHANISM

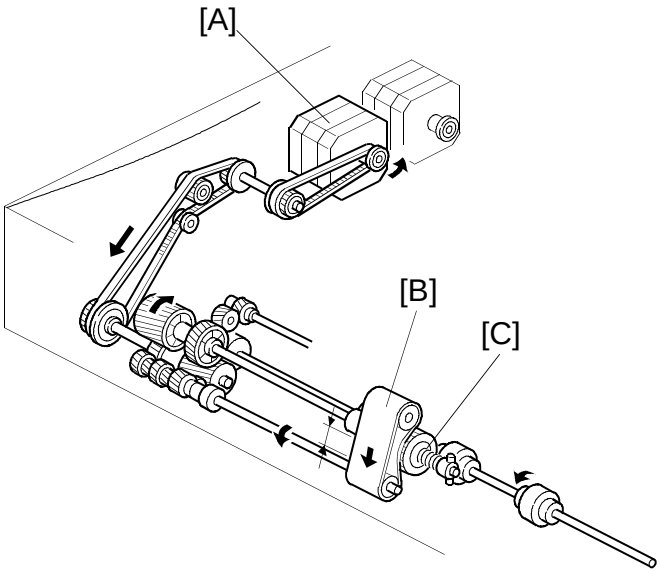


Originals are separated using the friction belt [A] and the feed roller [B]. When the copier sends a signal to the DF to feed in the original, the feed-in motor [C] starts rotating (clockwise) to drive the pick-up [D], feed and pull-out [E] rollers. A one-way bearing stops the friction belt from rotating. Originals are separated and fed in one by one because the resistance of the stationary friction belt is greater than the friction between pages of the original.

When the registration sensor [F] detects the separated first original, the feed-in motor reverses (counter clockwise), and the drive is transmitted only to the pull-out rollers due to a one-way bearing. In this condition, the pull-out rollers are still rotating in the same direction, and they feed the original to the exposure glass. The motor turns off when the trailing edge of the 1st original has finished passing over the sensor.

To prepare the next original, the feed-in motor turns clockwise to separate the second original and the motor turns off when the registration sensor detects the second original. When it is time for the second original to be fed to the exposure glass, the feed-in motor turns counter clockwise.

4.3 FRICTION BELT DRIVE MECHANISM

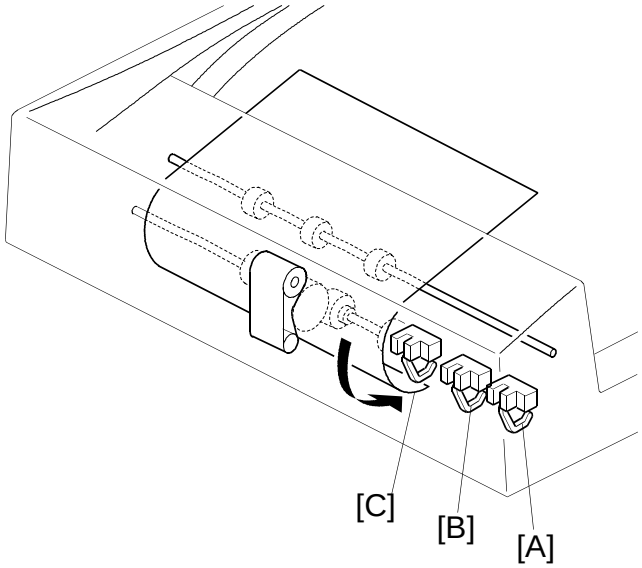


The feed-in motor [A] drives the friction belt [B] through timing belts and gears. The one-way bearing allows the belt to rotate in the direction shown only when the feed-in motor is rotating counterclockwise. (The feed-in motor rotates counterclockwise when the original is passing over the registration sensor, and only the pull-out rollers are rotating to feed the paper to the exposure glass.)

As a result of this operation, the part of the friction belt that contacts the feed roller [C] or the original changes. This prevents multiple feeding or causing originals to become dirty.

The reverse movement of the friction belt will not affect the next original because the pressure of the press lever holds the originals in place.

4.4 ORIGINAL SIZE DETECTION

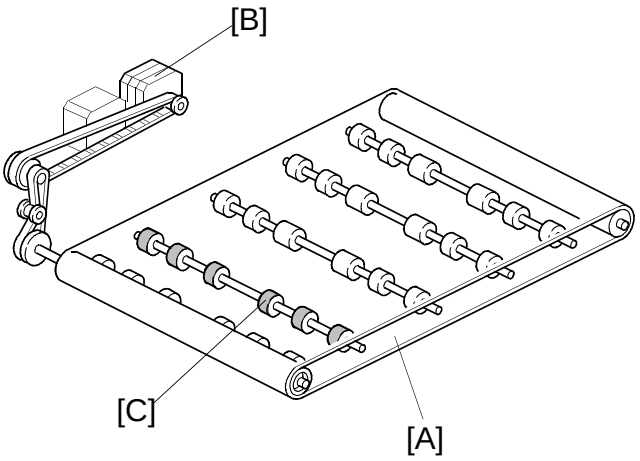


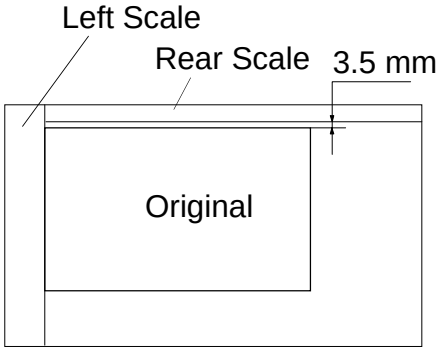
The DF detects original width using three original width sensors-1 [A], -2 [B] and -3 [C]. It also detects the original length using the registration sensor.

The DF CPU counts the feed-in motor's drive pulses during the on timing of the registration sensor. Based on this pulse count, the CPU determines the original length.

The machine detects the original size by the total combination of all four sensors.

4.5 PAPER TRANSPORT MECHANISM





The transport belt [A] is driven by an independent motor called the belt drive motor [B] (a dc stepper motor). The belt drive motor starts rotating soon after the copier sends an original feed-in signal.

Inside the transport belt are four pressure roller shafts, which achieve the proper amount of pressure between the belt and the original. The pressure roller shaft [C] closest to the left original scale is made of rubber for the stronger pressure that is required when in the thick original mode (this is the mode used for normal paper). The other rollers are sponge rollers.

Since the copier's original alignment position is at the left rear corner (not in the center), the originals fed from the DF must also be at this position. But if the original was to be fed along the rear scale, unnecessary original skew, jam or wrinkling may occur.

To prevent such problems, the original transfer position is set to 3.5 mm away from the rear scale as shown. The correction for this 3.5 mm gap is compensated for by the position of the lens unit. (Also see "Horizontal Lens Positioning" in the Optics section of the manual for the copier main body.)

4.6 THICK/THIN ORIGINAL MODES

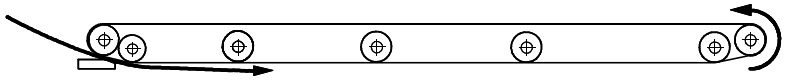


Fig. 1

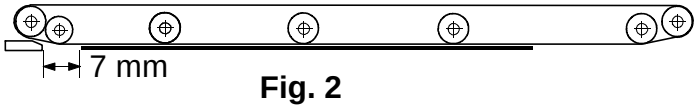


Fig. 2

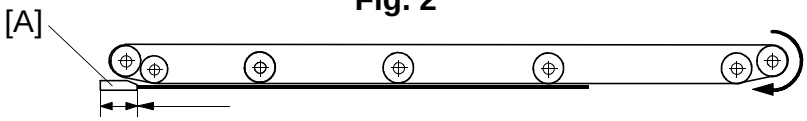


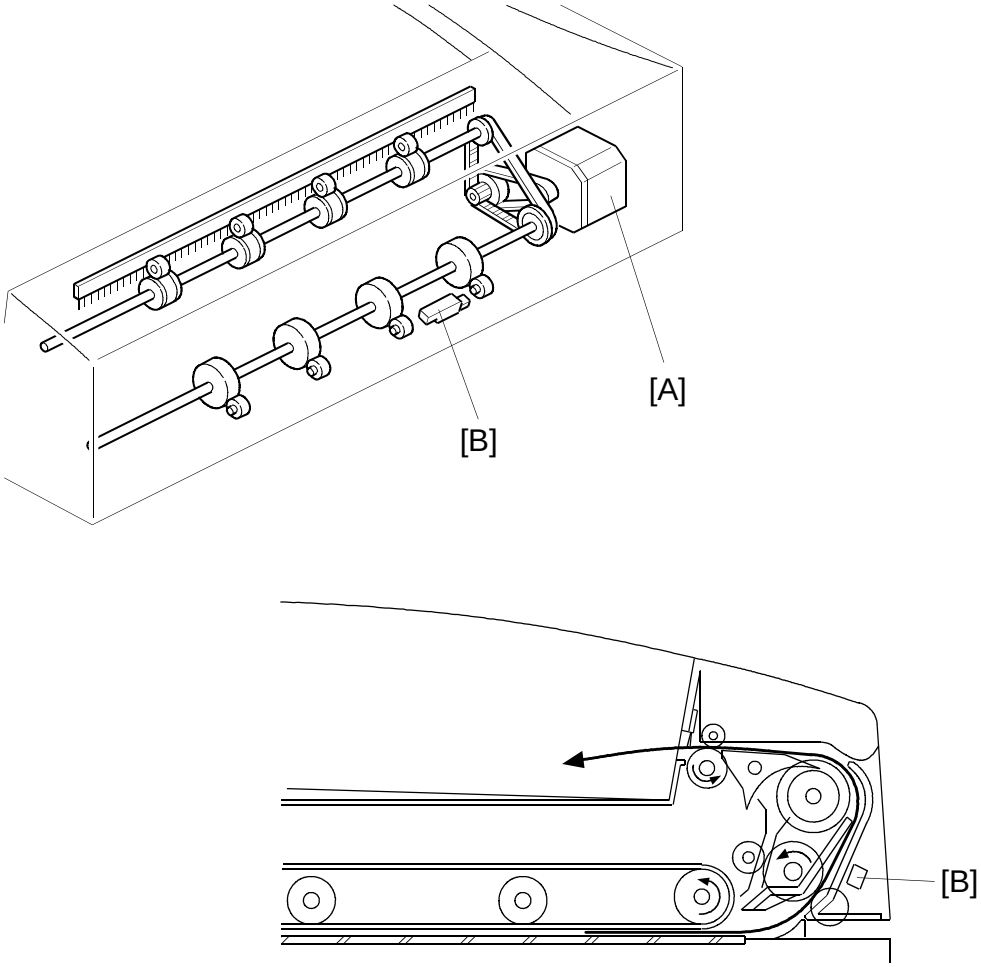
Fig. 3

This document feeder has two different ways of stopping originals at the correct position on the exposure glass. The technician can select one of these using a copier SP mode. The user can also select the mode.

1. Thick Original Mode (Normal Paper Mode)
   This mode is the factory set mode. The belt drive motor remains energized to carry the original approximately 7 mm past the left scale (Figures 1 and 2). Then the motor pauses and reverses to feed the original back against the left scale (Fig. 3). This forces the original to hit against the left original scale [A] and thus aligns the trailing edge to minimize the original skew on the exposure glass.

2. Thin Original Mode
   To protect originals from being damaged by the movements of the transfer belt, thin original mode can be selected. The belt drive motor stops shortly after the original trailing edge passes the registration sensor. This stops the original at the correct position on the exposure glass.

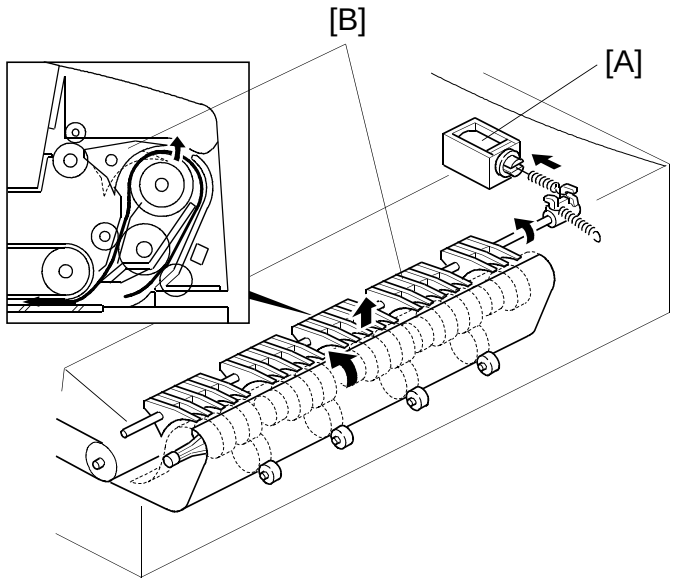
4.7 ORIGINAL FEED-OUT MECHANISM



When the scanner reaches the return position, the copier's CPU sends the feed-out signal to the DF CPU. When the DF receives the feed-out signal, the belt drive and feed-out motors [A] turn on.

The feed-out sensor [B] installed in the feed-out section counts the number of pulses to calculate how long the feed-out motor must stay on to feed the original out of the machine completely.

4.8 TWO-SIDED ORIGINAL FEED MECHANISM



Unlike one-sided original feed, the back side of the original must be copied first to keep the originals and copies in the correct order.

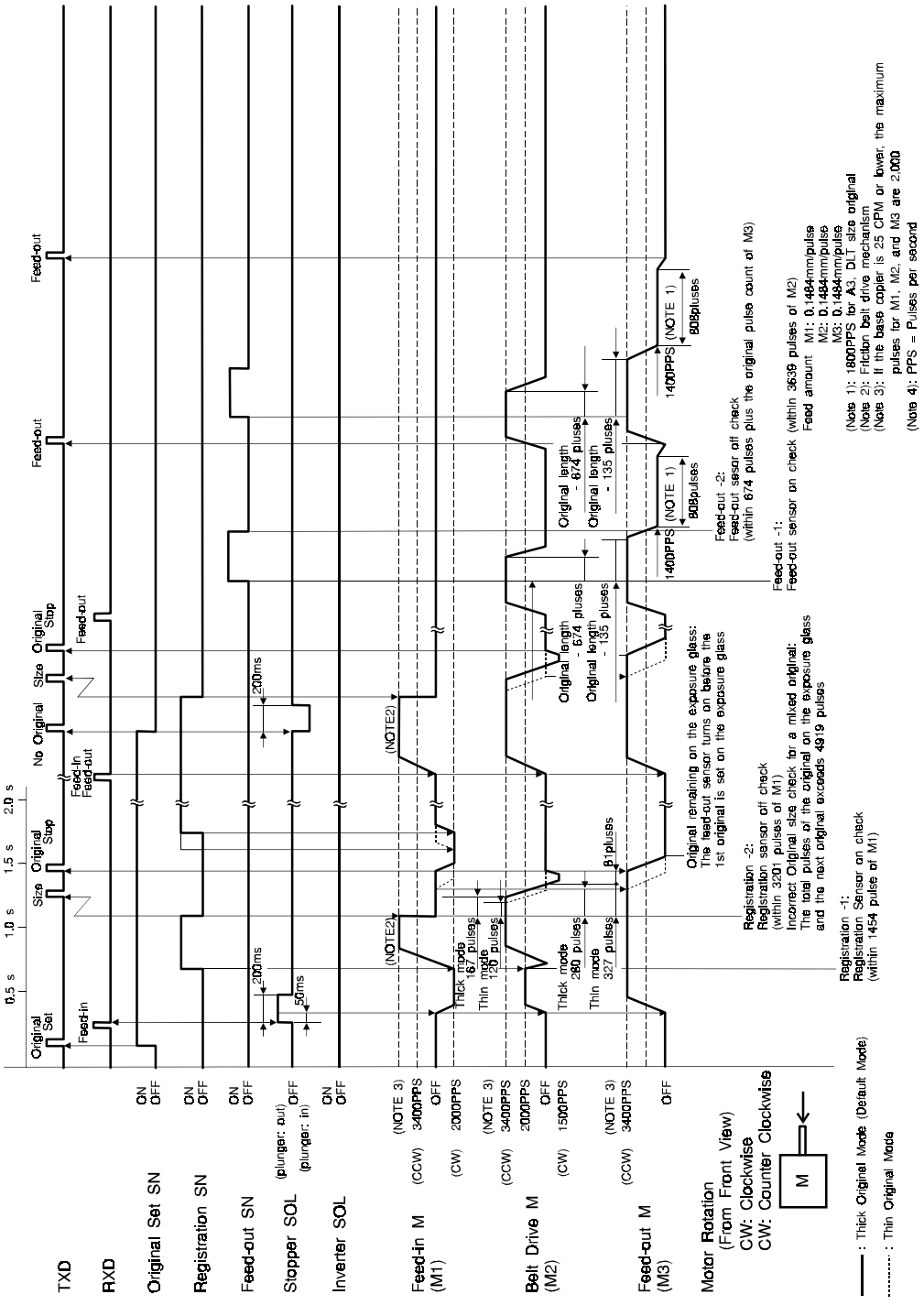
During original feed-in, the sequence is the same as for one-sided feed. However, the belt drive motor continues rotating until the original reaches the inverter section. The DF CPU also energizes the feed-out motor and the inverter solenoid [A] for a short time to lift the inverter pawls [B].

After the inverter mechanism inverts the original, the belt drive motor reverses and the original is fed towards the original scale. It is stopped at the correct position on the exposure glass, and the DF CPU sends the copy start signal.

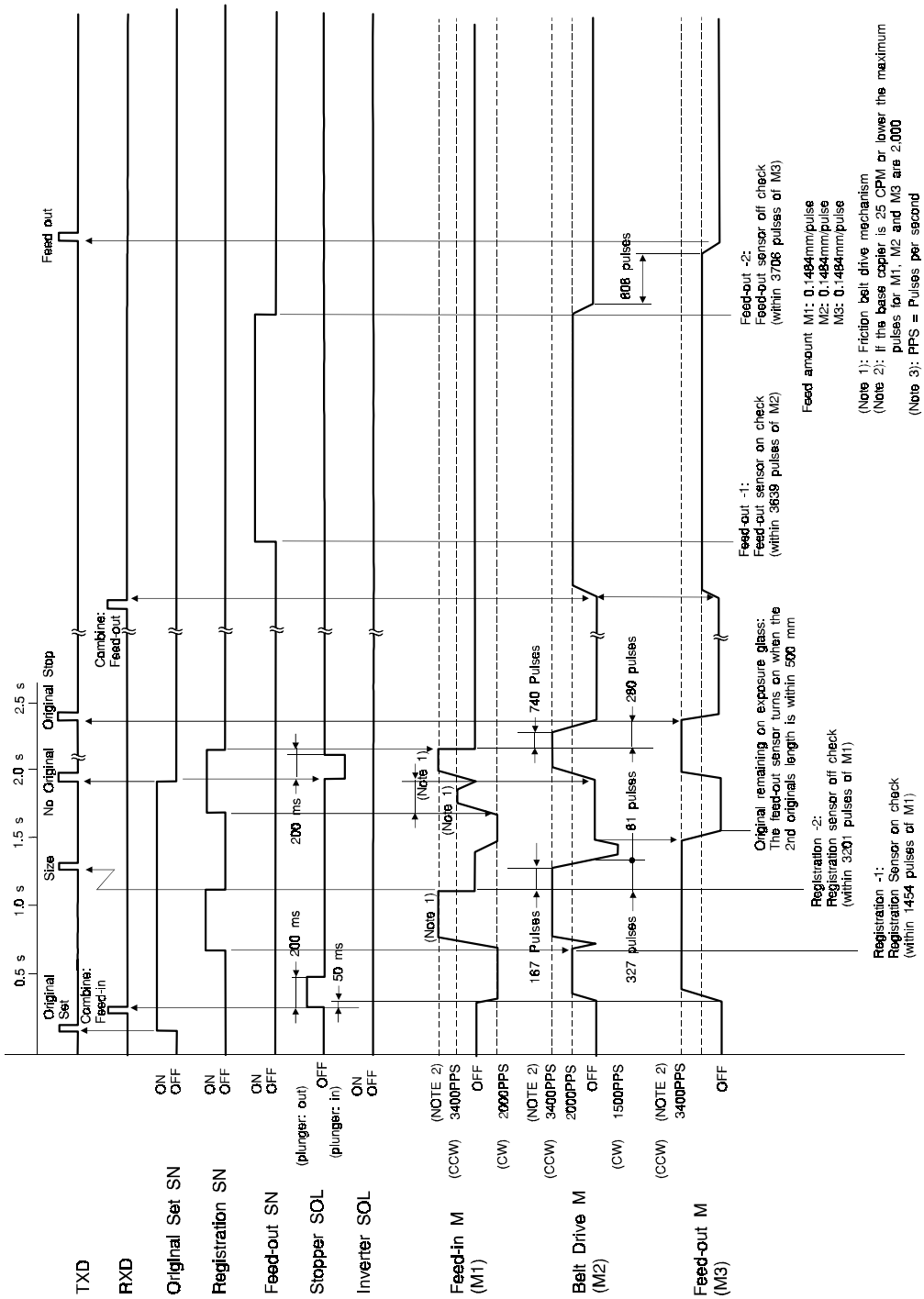
When the scanner reaches the return position, the copier's CPU sends the invert original signal to the DF CPU in order to make a copy of the front side. The original is inverted in the same way as for copying the back side, as explained earlier on this page.

5. TIMING CHARTS

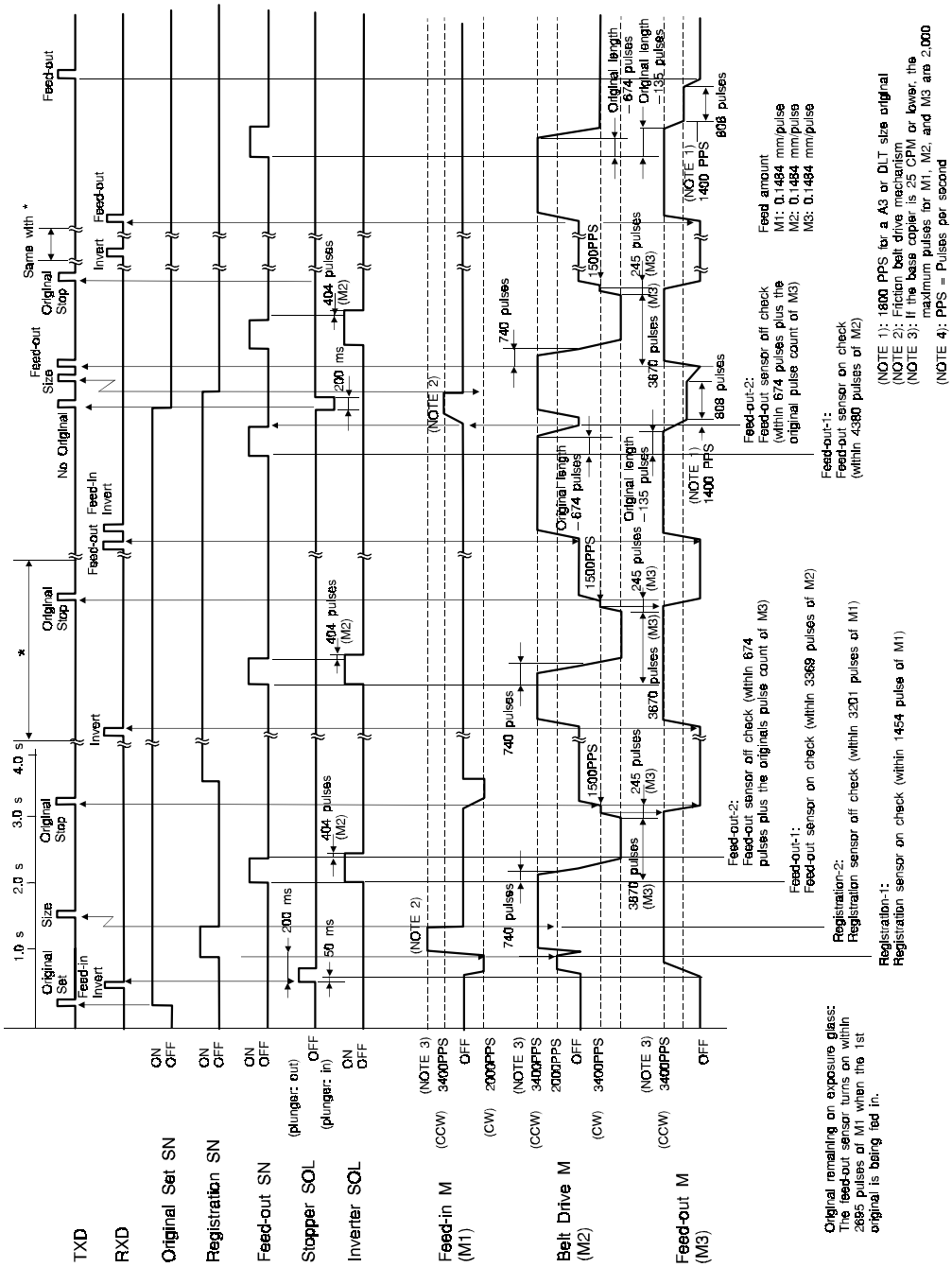
5.1 A4 SIDEWAYS: 1 SIDED ORIGINAL



5.2 COMBINE 2 ORIGINAL MODE



5.3 A4 SIDEWAYS: DUPLEX


TXD
RXD
Original Set SN
Registration SN
Feed-out SN
Stopper SOL
Inverter SOL
Feed-in M (M1)
Belt Drive M (M2)
Feed-out M (M3)
1.0 s
2.0 s
3.0 s
4.0 s
Original Set
Feed-in Invert
Size
Original Stop
Invert
Feed-out
No Original
Feed-in Invert
Same with *
200 ms
50 ms
404 pulses (M2)
740 pulses
1500PPS
245 pulses (M3)
3670 pulses (M3)
808 pulses
1400 PPS
(NOTE 1)
(NOTE 2)
(NOTE 3)
3400PPS
2000PPS
Original length – 674 pulses
Original length – 135 pulses
Feed-out-2: Feed-out sensor off check (within 674 pulses plus the originals pulse count of M3)
Feed-out-1: Feed-out sensor on check (within 3369 pulses of M2)
Registration-2: Registration sensor off check (within 3201 pulses of M1)
Registration-1: Registration sensor on check (within 1454 pulse of M1)
Feed-out-2: Feed-out sensor off check (within 674 pulses plus the original pulse count of M3)
Feed-out-1: Feed-out sensor on check (within 4380 pulses of M2)
Feed amount
M1: 0.484 mm/pulse
M2: 0.484 mm/pulse
M3: 0.484 mm/pulse
Original remaining on exposure glass: The feed-out sensor turns on within 2685 pulses of M1 when the 1st original is being fed in.
(NOTE 1): 1800 PPS for a A3 or DLT size original
(NOTE 2): Friction belt drive mechanism
(NOTE 3): If the base copier is 25 CPM or lower, the maximum pulses for M1, M2, and M3 are 2,000
(NOTE 4): PPS = Pulses per second

AUTO REVERSE DOCUMENT FEEDER A548

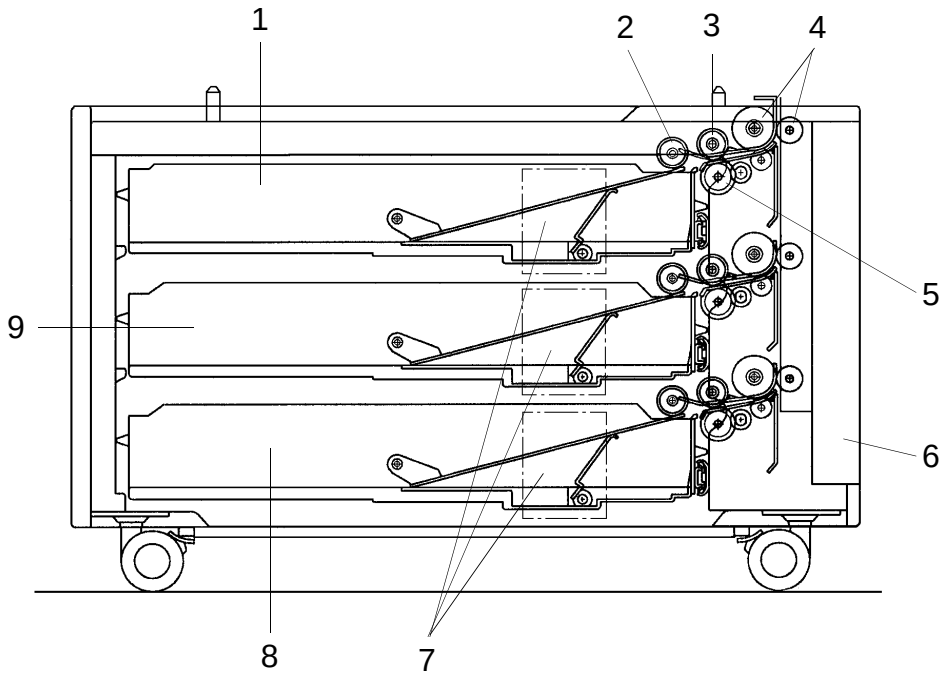
PAPER TRAY UNIT A550/549

1. SPECIFICATIONS

Configuration:	Two-tray table or three-tray table
Copy Paper Size:	Maximum A3/11" X 17" Minimum B5/8 1/2" X 11"
Copy Paper Weight:	52 - 105 g/m^2, 14 - 28 lb
Copy Paper Capacity:	Approximately 500 sheets
Paper Feed Speed:	20 ~ 40 copies/minute (A4 / 8 1/2"X11" sideways)
Power Source:	DC 24V, 5V and AC 120V, 220~240V from the main machine
Power Consumption:	Maximum 110.5 W Average 50 W
Dimensions:	620 mm/24.4" (width) X 632 mm /24.9" (depth) X 390 mm/15.4" (height)
Weight:	Less than 36 kg/79.4 lb (Two-tray type) Less than 38 kg/83.8 lb (Three-tray type)

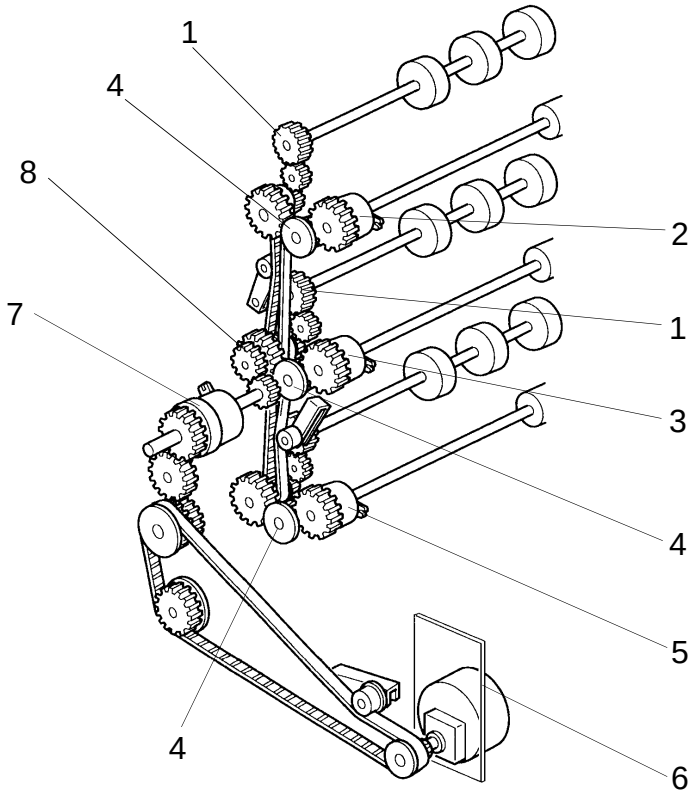
2. COMPONENT LAYOUT

2.1 MECHANICAL COMPONENT LAYOUT



1. Paper Tray 1
2. Pick-up Roller
3. Paper Feed Roller
4. Relay Rollers
5. Reverse Roller
6. Lower Right Door
7. Paper Lift Motors
8. Paper Tray 3 (A549 model only)
9. Paper Tray 2

2.2 DRIVE LAYOUT



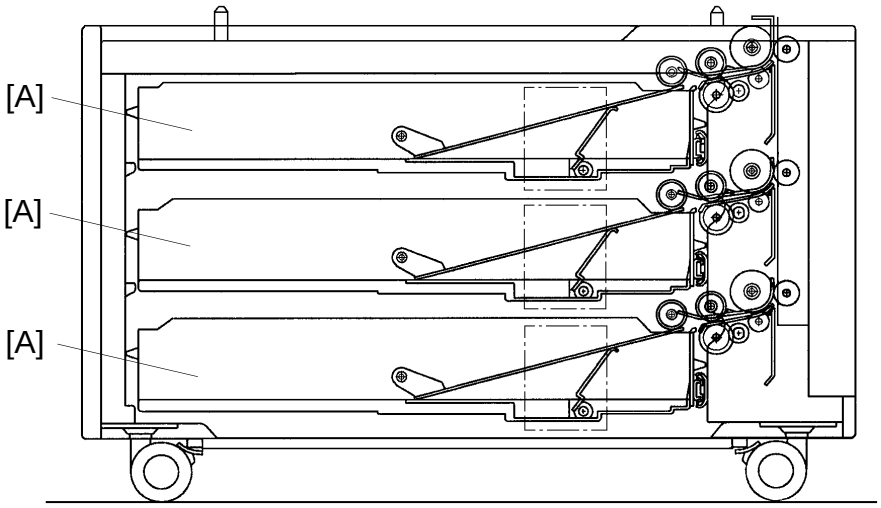
1. Vertical Transport Roller Gears
2. Paper Feed Clutch 1
3. Paper Feed Clutch 2
4. Separation Roller Gears
5. Paper Feed Clutch 3
6. Main Motor
7. Relay Clutch
8. Timing Pulley

2.3 ELECTRICAL COMPONENT DESCRIPTION

Refer to the electrical component layout on the reverse side of the Point to Point Diagram (on waterproof paper).

Symbol	Index No.	Description	Note
Motors			
M1	5	Main	Drives all the components of the paper tray
M2	2	Tray lift 1	Raises the bottom plate in the paper tray
M3	30	Tray lift 2	
M4	29	Tray lift 3 (A549 only)	
Circuit board			
PCB1	1	Interface board	Controls the paper tray in response to signals from the copier
Sensors			
S1	7	Tray upper limit 1	Detects the top of the stack to stop the tray lift motor
S2	18	Tray upper limit 2	
S3	19	Tray upper limit 3 (A549 only)	
S4	25	Relay 1	Detects the leading edge of the paper as it leaves the tray to control pick-up solenoid and jam detection timing
S5	23	Relay 2	
S6	20	Relay 3 (A549 Only)	
S7	28	Paper end 1	Detects when the paper tray is empty
S8	24	Paper end 2	
S9	21	Paper end 3 (A549 only)	
Switches			
SW1	22	Tray cover	Detects whether the tray unit cover is open and cuts the 24 Vdc power if it is
SW2	3	Tray set 1	Detects whether the paper tray is in place
SW3	4	Tray set 2	
SW4	6	Tray set 3 (A549 only)	
Magnetic clutches			
CL1	9	Paper feed 1	Starts feeding paper from the tray
CL2	12	Paper feed 2	
CL3	15	Paper feed 3 (A549 only)	
CL4	11	Relay	Drives the rollers in the paper trays
Solenoids			
SOL1	8	Paper pick-up 1	Lifts/drops the pick-up roller
SOL2	13	Paper pick-up 2	
SOL3	16	Paper pick-up 3 (A549 only)	
SOL4	10	Separation 1	Lifts/drops the separation roller
SOL5	14	Separation 2	
SOL6	17	Separation 3 (A549 Only)	
Heaters			
H1	26	Tray (Option)	Turns on when the main switch is off to keep the paper in the trays dry
H2	27	Tray (Option)	

3. OVERVIEW

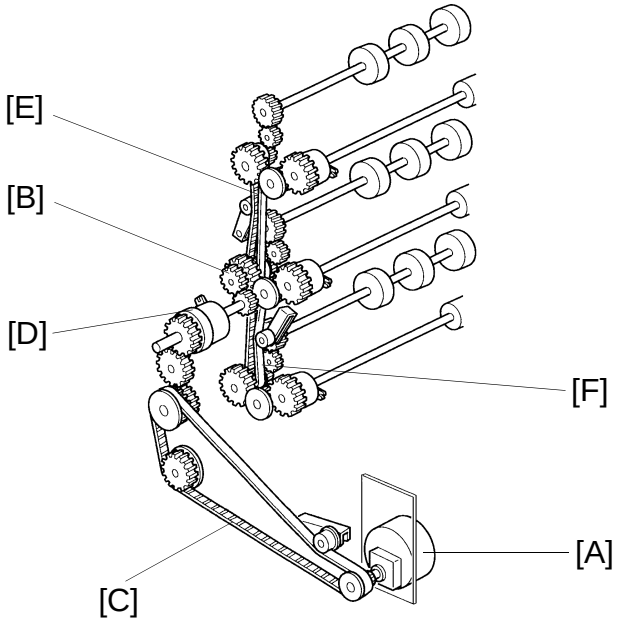


There are two types of paper tray unit: the two-tray and three-tray types. Each paper tray [A] is a drawer type that can hold up to 500 sheets of paper.

The paper feed mechanism uses an FRR feed system. The function of the system is exactly the same as for the main machine except that there is no paper size detection. The paper size for each paper tray is input at the operation panel, either by the user or by a technician.

All the electrical components of the paper tray are controlled by the copier main board through the tray interface board.

4. DRIVE MECHANISM



All the tray rollers are driven by the main motor [A] via timing belts, clutches and a train of gears.

Drive is transmitted to the timing pulley [B] through the timing belt [C], relay clutch [D] and the gears.

Paper Feed Unit 1:
The drive from the timing pulley is transmitted to the unit through the timing belt [E].

Paper Feed Unit 2:
The drive from the timing pulley is directly transmitted to the unit.

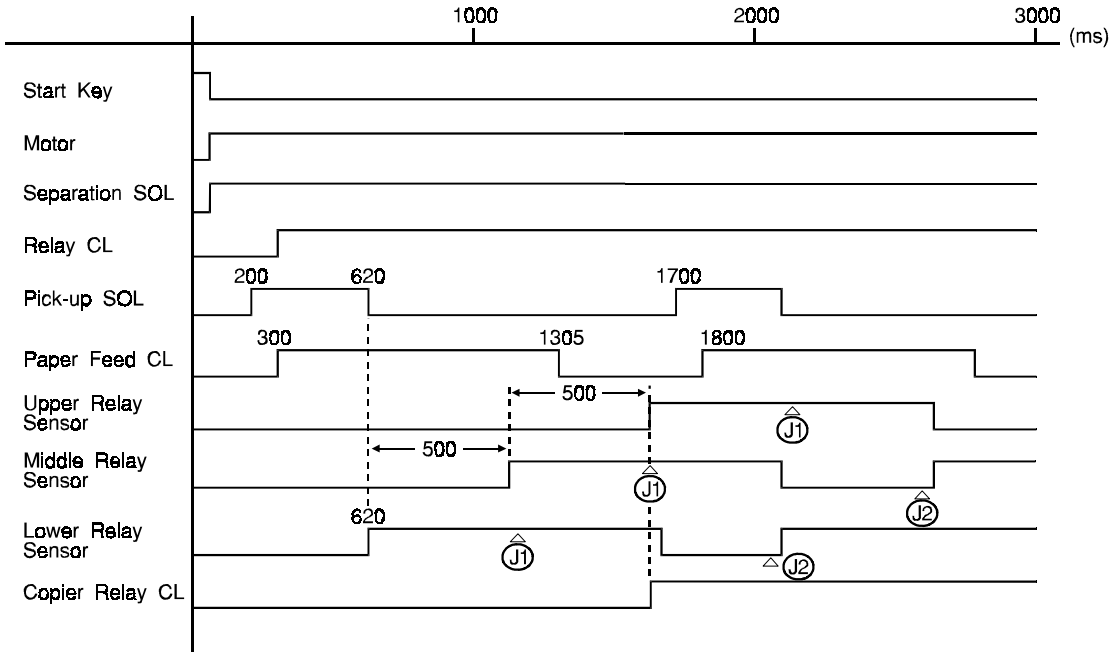
Paper Feed Unit 3:
The drive from the timing pulley is transmitted to the unit through the timing belt [F].

The main motor and the relay clutch are energized at the same time that the Start key is pressed.

The paper feed clutch is energized 300 ms after the main motor starts to rotate. When the paper feed clutch for the selected paper tray is energized, paper is fed from the paper tray to the main machine through the relay rollers.

5. PAPER FEED AND MISFEED DETECTION TIMING

A4 Sideways, Lower Paper Feed Station, Line speed 200 mm/s



J1 and J2: Checks whether the sensor is activated within 500 ms after the designated time for these sensors.

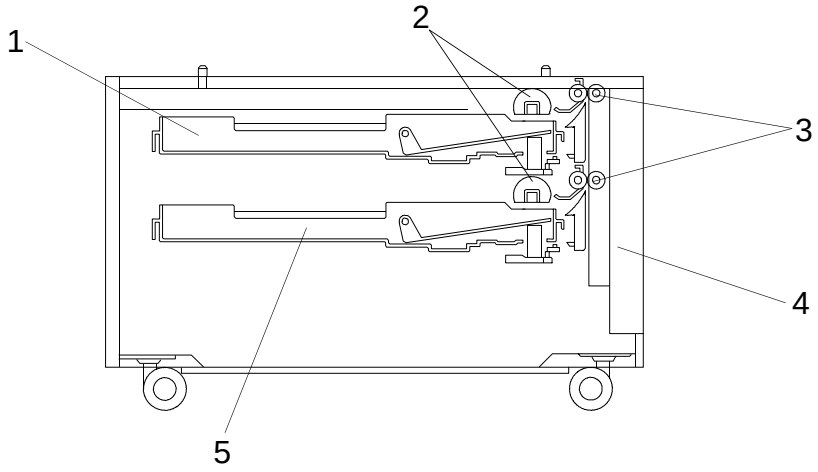
PAPER TRAY UNIT A553

1. SPECIFICATIONS

Configuration:	Two-tray table
Copy Paper Size:	Maximum A3/11" x 17" Minimum B5/8 1/2" x 11"
Copy Paper Weight:	64 - 90 g/m^2, 17 - 24 lb
Copy Paper Capacity:	Approximately 250 sheets
Paper Feed Speed:	20 ~ 35 copies/minute (A4 / 8 1/2"X11" sideways)
Power Source:	DC 24V, 5V and AC 120V, 220~240V from the main machine
Power Consumption:	Maximum 43 W Average 22 W
Dimensions:	620 mm/24.4" (width) X 632 mm /24.9" (depth) X 390 mm/15.4" (height)
Weight:	Less than 30 kg/66 lb

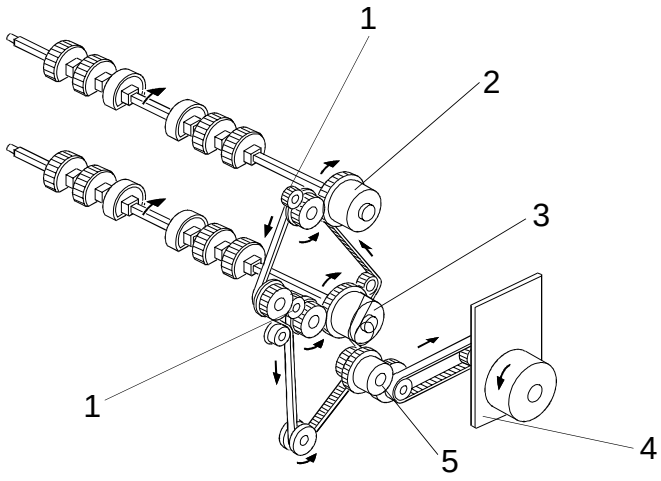
2. COMPONENT LAYOUT

2.1 MECHANICAL COMPONENT LAYOUT



1. Paper Tray 1
2. Paper Feed Rollers
3. Relay Rollers
4. Lower Right Door
5. Paper Tray 2

2.2 DRIVE LAYOUT

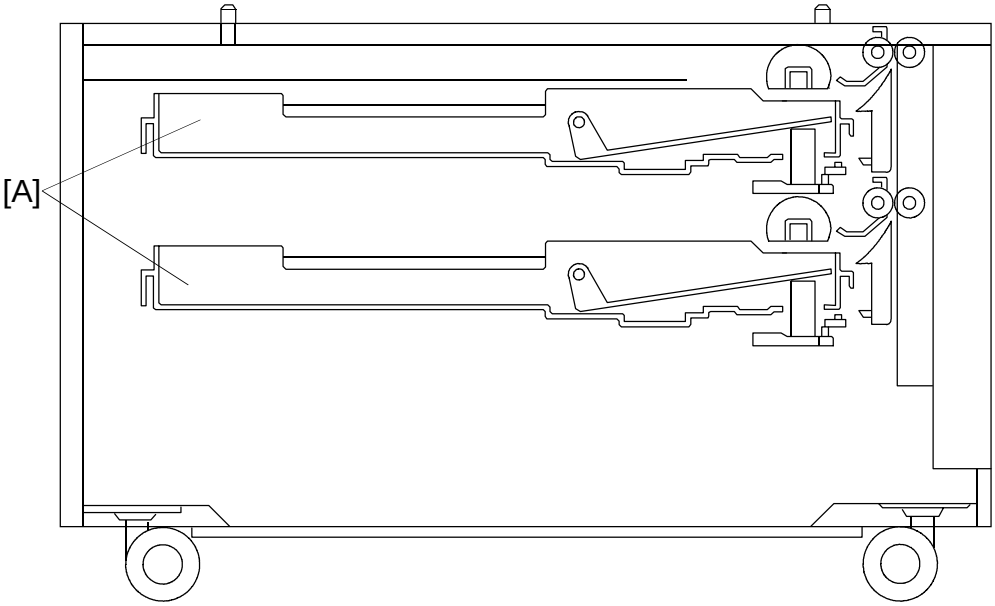


1. Vertical Transport Roller Gears
2. Paper Feed Clutch 1
3. Paper Feed Clutch 2
4. Main Motor
5. Relay Clutch

2.3 ELECTRICAL COMPONENT DESCRIPTION

Refer to the electrical component layout on the reverse side of the Point to Point Diagram (on waterproof paper).

Symbol	Index No.	Description	Note
Motors			
M1	4	Main	Drives all the paper tray components
Circuit board			
PCB1	1	Interface board	Controls the paper feed tray unit in response to signals from the copier
Sensors			
S1	2	Tray set 1	Detects whether the paper tray is in place
S2	3	Tray set 2	
S3	10	Relay 1	Detects when the leading edge of the paper leaves the paper tray, to determine copier relay clutch timing and jam detection timing
S4	11	Relay 2	
S5	5	Paper end 1	Detects when the paper tray runs out of paper
S6	6	Paper end 2	
Switches			
SW1	12	Tray cover	Detects whether the tray unit cover is open, and cuts the 24 Vdc line if it is.
Clutches			
CL1	7	Paper feed 1	Starts to feed paper from the tray
CL2	8	Paper feed 2	
CL3	9	Relay	Drives the rollers in the paper trays
Heaters			
H1	13	Tray (Option)	Turns on when the main switch is off, to keep the paper in the trays dry
H2	14	Tray (Option)	

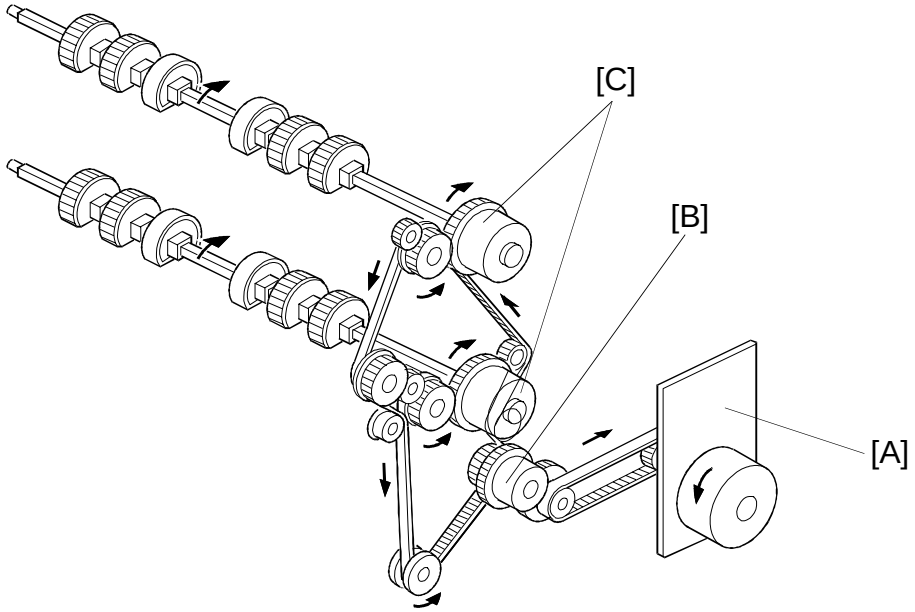


This paper feed unit is a two-tray type. Each paper tray [A] is a drawer type that can hold up to 250 sheets of paper.

The paper feed mechanism uses a corner separator system. The function of the system is exactly the same as for the main machine except that there is no paper size detection. The paper size for each paper tray is input at the operation panel, either by the technician or by the user.

All the electrical components of the paper tray are controlled by the copier main board through the tray interface board.

4. DRIVE MECHANISM



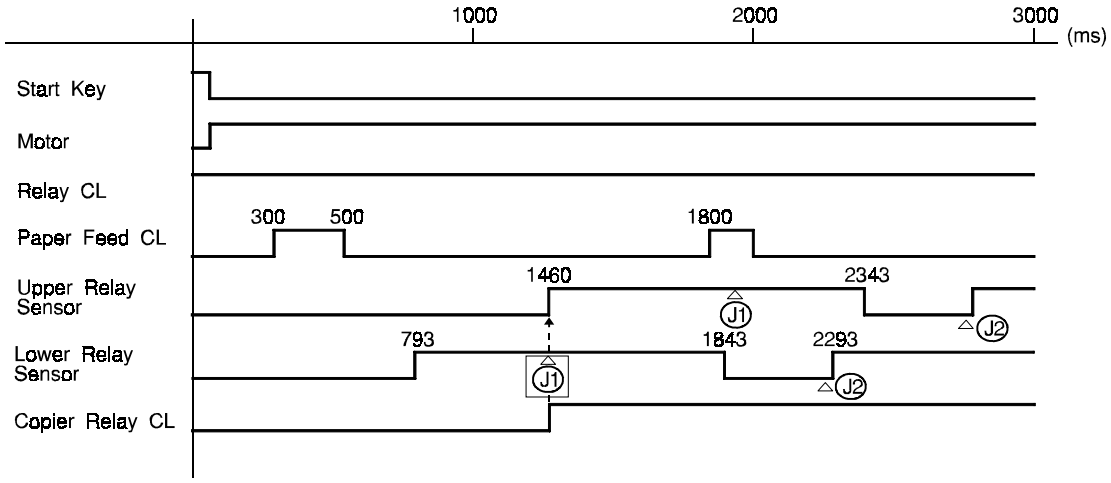
All the tray rollers are driven by the main motor [A] via timing belts, clutches and a train of gears.

The main motor and the relay clutch [B] are energized at the same time as the Start key is pressed.

The paper feed clutch [C] is energized 300 ms after the main motor starts to rotate. When the paper feed clutch for the selected paper tray is energized, paper is fed from the paper tray to the main frame through the relay rollers.

5. PAPER FEED AND MISFEED DETECTION TIMING

A4 Sideways. Lower Paper Feed Station 200 mm/s



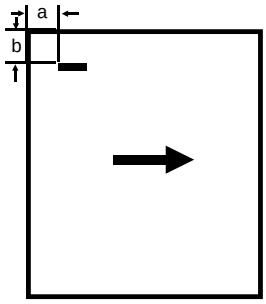
J1 and J2: Checks whether the sensor is activeted within 667 ms after the designated time for these sensor.

SORTER STAPLER A554

1. SPECIFICATIONS

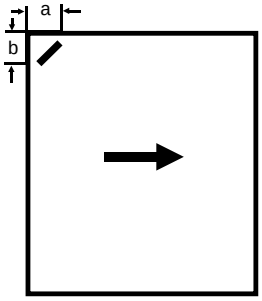
Paper Size for Bins:	Sort or stack mode: Maximum: A3, 11" x 17" Minimum: A5, 5 1/2" x 8 1/2" lengthwise Staple mode: Maximum: A3, 11" x 17" Minimum: B5, 8 1/2" x 11"
Paper Weight for Bins:	Sort mode: 52 - 93 g/m^2, 14 - 24 lb Stack mode: 64 - 93 g/m^2, 17 - 24 lb Staple mode: 52 - 80 g/m^2, 14 - 21 lb
Number of Bins:	20 bins + proof tray
Bin Capacity:	Sort mode: 30 sheets (A4, 8 1/2" x 11") 15 sheets (A3, 11" x 17") Stack mode: 15 sheets Proof tray - 100 sheets (52 – 80 g/m^2, 14 – 21 lb) - 50 sheets (81 – 128 g/m^2, 22 – 34 lb) - 30 sheets (129 – 157 g/m^2, 35 – 42 lb)
Stapler Capacity:	A4, 8 1/2" x 11" or smaller: 2 – 20 copies B4, 8 1/2" x 14" or larger: 2 – 10 copies
Stapling Position:	

(Horizontal)



a = b
= 6 ± 3 mm
= 0.24" ± 0.12"

(Diagonal)

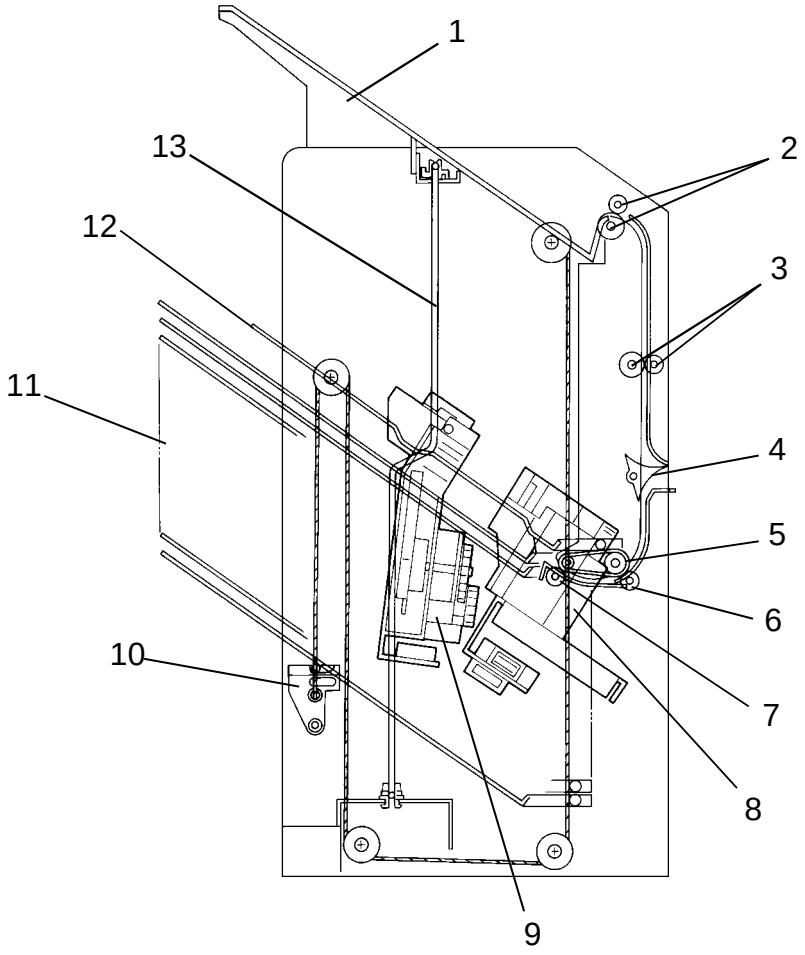


a = 16 ± 3 mm
= 0.63" ± 0.12"
b = 10 ± 3 mm
= 0.39" ± 0.12"

Staple Replenishment:	Cartridge exchange (3,000 staples/cartridge)
Power Source:	DC 24V, 5V (form the copier)
Power Consumption:	34 W
Dimensions: (W x D x H)	412 x 600 x 690 mm (16.2" x 23.6" x 27.1")
Weight:	About 25 kg, 55.1 lb (Main Frame: 22 kg, 48.5 lb Mounting Frame: 3 kg, 6.6 lb)

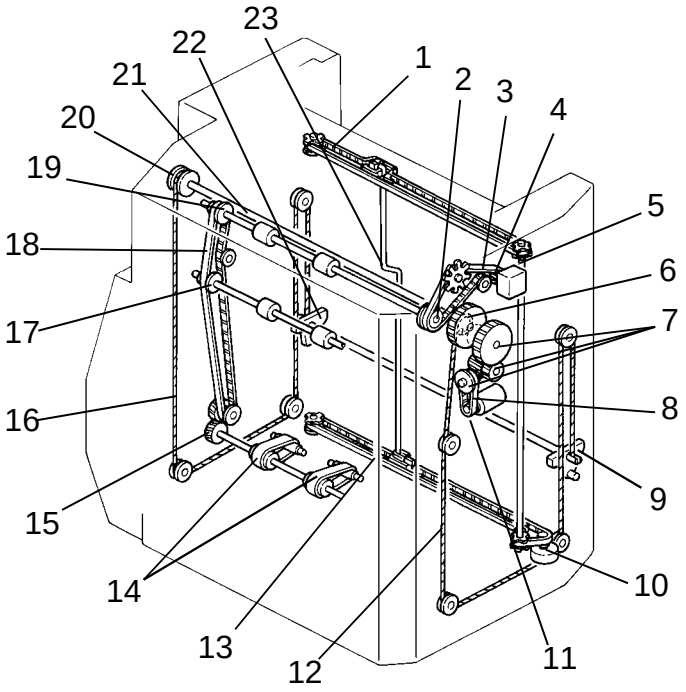
2. COMPONENT LAYOUT

2.1 MECHANICAL COMPONENT LAYOUT



1. Proof Tray
2. Proof Tray Exit Rollers
3. Vertical Transport Rollers
4. Turn Gate
5. Bin Transport Belt
6. Bin Transport Roller
7. Bin Exit Roller
8. Stapler
9. Grip Assembly
10. Bin Support Block
11. Bins
12. Support Bin
13. Jogger Bar

2.2 DRIVE LAYOUT



4. Roller Drive Motor Pulley
3. Rear Roller Drive Belt
2. Proof Tray Exit Roller Pulley (Rear)
(Proof Tray Exit Roller)
19. Proof Tray Exit Roller Pulley (Front)
18. Front Roller Drive Belt
17. Vertical Transport Drive Pulley
15. Bin Transport Drive Gear
14. Bin Transport Belts

11. Bin Lift Motor Pulley
8. Bin Lift Drive Belt
7. Bin Lift Gears
6. Bin Lift Gear/Pulley
12. Rear Bin Lift Wire
9. Rear Bin Support Block

21. Bin Drive Shaft
20. Front Bin Lift Pulley
16. Front Bin Lift Wire
22. Front Bin Support Block

10. Jogger Motor Pulley
13. Lower Jogger Drive Belt
5. Jogger Drive Shaft
1. Upper Jogger Drive Belt
23. Jogger Bar

2.3 ELECTRICAL COMPONENT DESCRIPTION

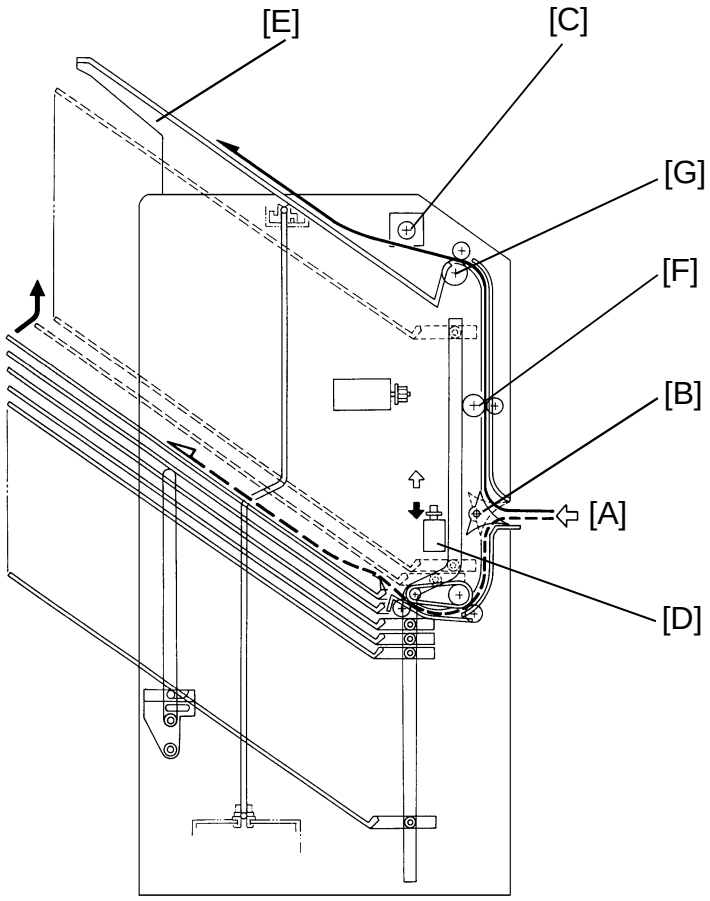
Refer to the electrical component layout on the reverse side of the Point to Point diagram (on waterproof paper).

Symbol	Name	Function	Index No.
Motors			
M1	Bin Lift	Lifts and lowers the bins via a belt, gears, and wires.	23
M2	Jogger	Drives the jogger bar to jog the copies against the front side plate.	20
M3	Grip	Drives the grip assembly into the bin to grip the copies and bring them to the stapling position.	13
M4	Stapler	Feeds the staples and drives the stapler hammer.	12
M5	Roller Drive	Drives the proof tray exit, vertical transport rollers, and bin transport belts.	1
Circuit Board			
PCB1	Main Control	Controls all sorter stapler functions.	18
Solenoid			
SOL 1	Turn Gate	Opens and closes the turn gate to direct the copies into either the proof tray or the bins.	6
Sensors			
S1	Bin Lift Timing -1	Monitors the rotation of the bin lift motor by detecting the timing disk.	24
S2	Bin Lift Timing -2	Controls the stop timing of the bin lift motor so that the bin lift timing sensor no. 1 can detect the timing disk properly.	25
S3	Jogger H.P.	Detects whether the jogger bar is at the home position.	19
S4	Paper	Detects whether there are any copies under the hammer.	8
S5	Bin (LED)	Detects whether there is any paper in the bins (light emitting element).	3
S6	Bin (Photo transistor)	Detects whether there is any paper in the bins (light receiving element).	17
S7	Grip H.P.	Detects whether the grip assembly is at the home position.	16
S8	Bin H.P.	Detects whether all the bins are in the down (home) position.	15
S9	Bin Exit	Detects paper jams at the bin exit area.	5
S10	Proof Tray Exit	Detects paper jams at the proof tray exit area.	4
S11	Roller Drive Timing	Monitors the roller drive motor speed by detecting the timing disk.	2

Symbol	Name	Function	Index No.
Switches			
SW1	Upper Lift Limit	The bin lift motor stops when this switch detects the upper limit position of the bins.	22
SW2	Wire Tension	The bin lift motor stops when this switch detects the lower limit position of the bins through the bin lift wire tension.	21
SW3	Front Door	Cuts the 24 Vdc line when the front door is open.	14
SW4	Sorter Stapler Set	Cuts the 24 Vdc line when the sorter stapler unit is open.	7
SW5	Staple End	Detects the staple end condition.	10
SW6	Staple Guide	Detects whether the staple guide plate is closed.	9
SW7	Staple H.P.	Detects whether the staple hammer is at the home position.	11

3. BASIC OPERATION

3.1 NORMAL MODE AND SORT/STACK MODE



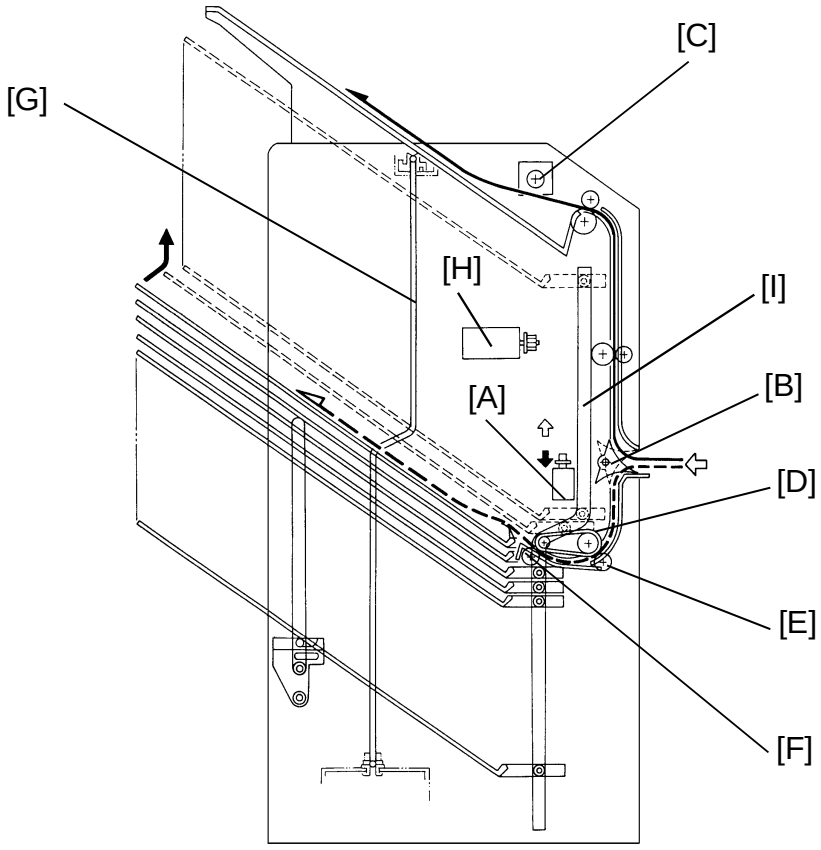
Copies [A] exiting the copier pass through the entrance guide plates to the turn gate area. The turn gate [B] will send copies either to the proof tray or to the bins, depending on the mode.

- Normal mode -

In this mode, copies pass from the turn gate section to the proof tray.

When the copier signals the S/S CPU to start the motor, the roller drive motor [C] rotates all the rollers in the S/S paper path. At the same time, the turn gate solenoid [D] is energized and the turn gate turns clockwise. The turn gate directs copies to the proof tray [E] through the vertical transport and proof tray exit rollers [F and G].

- Sort/Stack mode -



In this mode, copies pass from the turn gate section to the bins.

The turn gate solenoid [A] stays off and the turn gate [B] stays up when the S/S roller drive motor [C] starts rotating. The turn gate directs copies downward and the bin transport belt [D] exits copies to the bin through the bin transport and bin exit rollers [E and F].

The jogger bar [G] then moves the copy towards the front and jogs it against the front side plate to square the copies.

The bin lift motor [H] turns on when this jogging operation is almost finished and advances the bin one step up along the bin cam track [I]. The bin lift motor stops at the proper time to position the next bin at the bin exit area. This bin movement is done for each copy in sort mode and for the final copy of each original in stack mode.

The up and down movement of the bins in both sort and stack modes is the same as for other moving bin type sorters.

3.2 STAPLE MODE

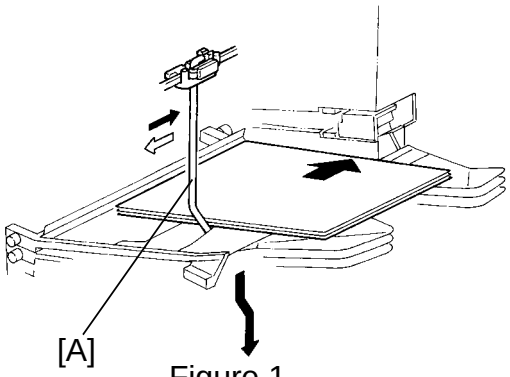


Figure 1

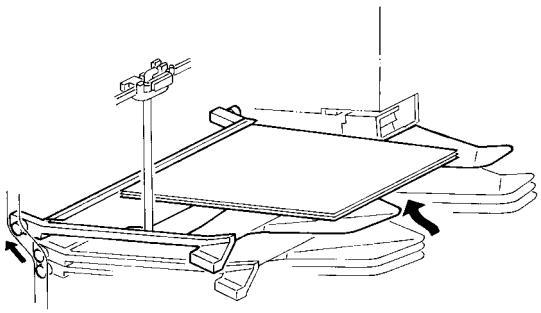


Figure 2

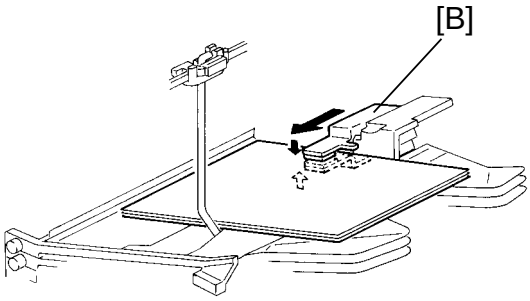


Figure 3

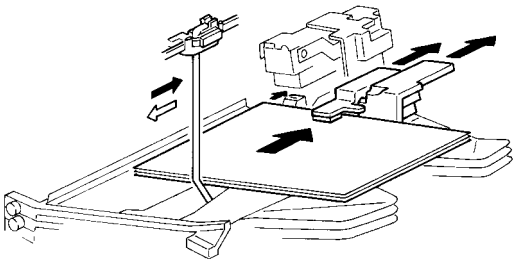


Figure 4

When the final set of copies has been jogged in sort mode, the staple unit staples the stacked copies as follows:

Figure 1:
If the final copy is fed out to a bin other than the first one, all the bins lower to the home position (the first bin is positioned at the bin exit area). The jogger bar [A] moves towards the front to jog the copies stacked in the first bin. Then it stops 15 mm away from the side edge of the paper.

Figure 2:
The bins move one step up to place the first bin at the stapling position.

Figure 3:
The grippers [B] move forward, and grip the copies.

Figure 4:
The grippers bring the copies up underneath the stapler. At the same time, the jogger bar jogs the copies stacked in the second bin to prepare for the next stapling operation. Then the jogger bar returns to the position 15 mm away from the side edge of the paper.

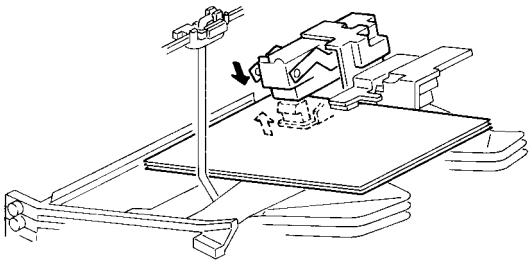


Figure 5

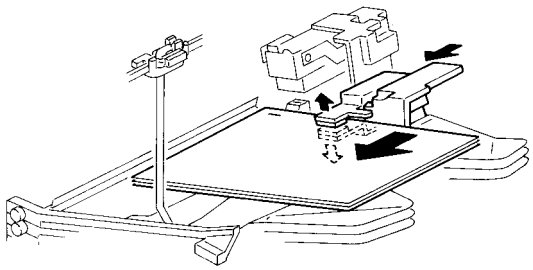


Figure 6

Figure 5:
The stapler staples the copies.

Figure 6:
The copies are pushed back into the bin. Then the grippers open and return to the home position.

The bins move one step up for the next stapling operation.

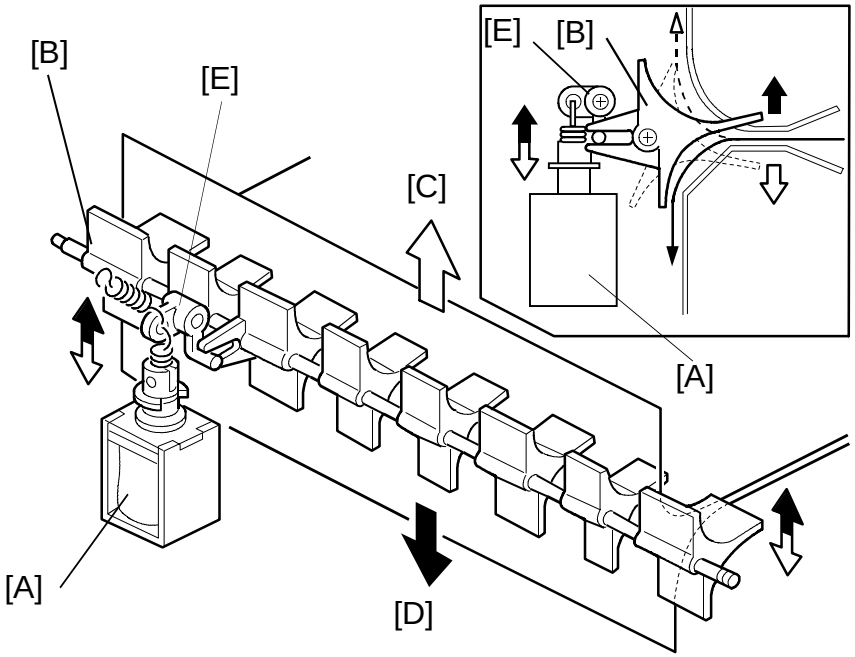
When the final set of copies is stapled, the bins lower and stop when the final bin that was used just before the entire stapling operation is positioned at the bin exit.

There are two staple modes.

1) Automatic stapling:
   In ADF/ARDF mode, when the user selects staple mode before pressing the Start key, the copies will be delivered to each bin and stapled automatically.

2) Manual stapling:
   In sort mode, after copies are sorted in the bins, the copies will be stapled when the user presses the staple key after copying. In stack mode, manual stapling is impossible.

4. TURN GATE SECTION



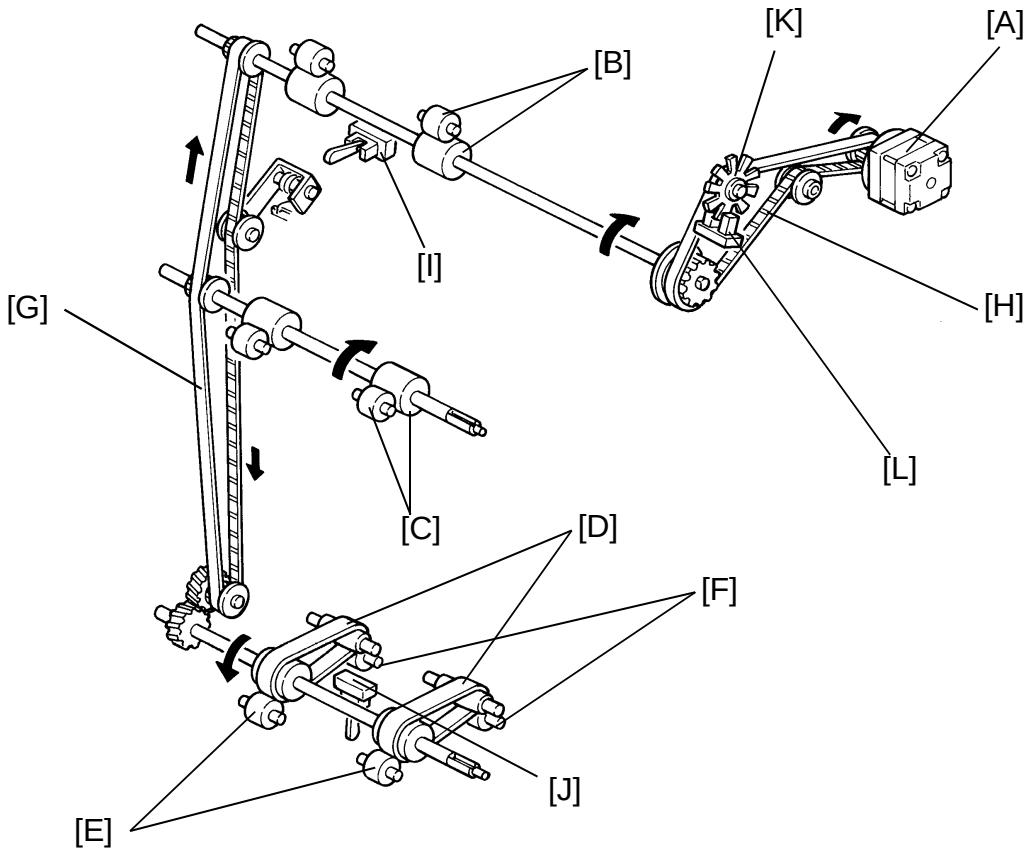
The turn gate directs copies to the proof tray or to the bins depending on the mode selected.

In the normal mode, the turn gate solenoid [A] turns on together with the roller drive motor when the copier signals the S/S CPU to start the motor. The turn gate [B] rotates clockwise to direct copies upward [C] through the vertical transport section to the proof tray. The turn gate solenoid stays on during the copy cycles, and turns off when the proof tray exit sensor detects the trailing edge of the last copy and the S/S CPU receives the signal from the copier to stop the motor.

In the sort, stack, or staple mode, the turn gate solenoid stays off to keep the turn gate up so that copies are directed downward [D] to the bin transport section.

The solenoid lever [E] is bent at a right angle to ensure that the lever moves only if the solenoid switches from on to off, or from off to on.

5. ROLLER DRIVE AND CONTROL



The roller drive motor (a stepper motor) [A] drives the proof tray exit rollers [B], vertical transport rollers [C], bin transport belts [D], bin transport rollers [E], and bin exit rollers [F] via the front and rear roller drive belts [G and H], pulleys, and gears, as shown above.

The roller drive motor turns on when the copier signals the S/S CPU to switch the motor on. When the proof tray exit sensor [I] (in the normal mode) or the bin exit sensor [J] (in the sort/stack/staple mode) detects the trailing edge of the final copy, the S/S CPU informs the copier through the fiber cable and the interface PCB. Then the copier signals the S/S to stop the roller drive motor.

The S/S CPU monitors the roller drive motor speed by counting pulses from the timing disc [K] through the roller drive timing sensor [L].

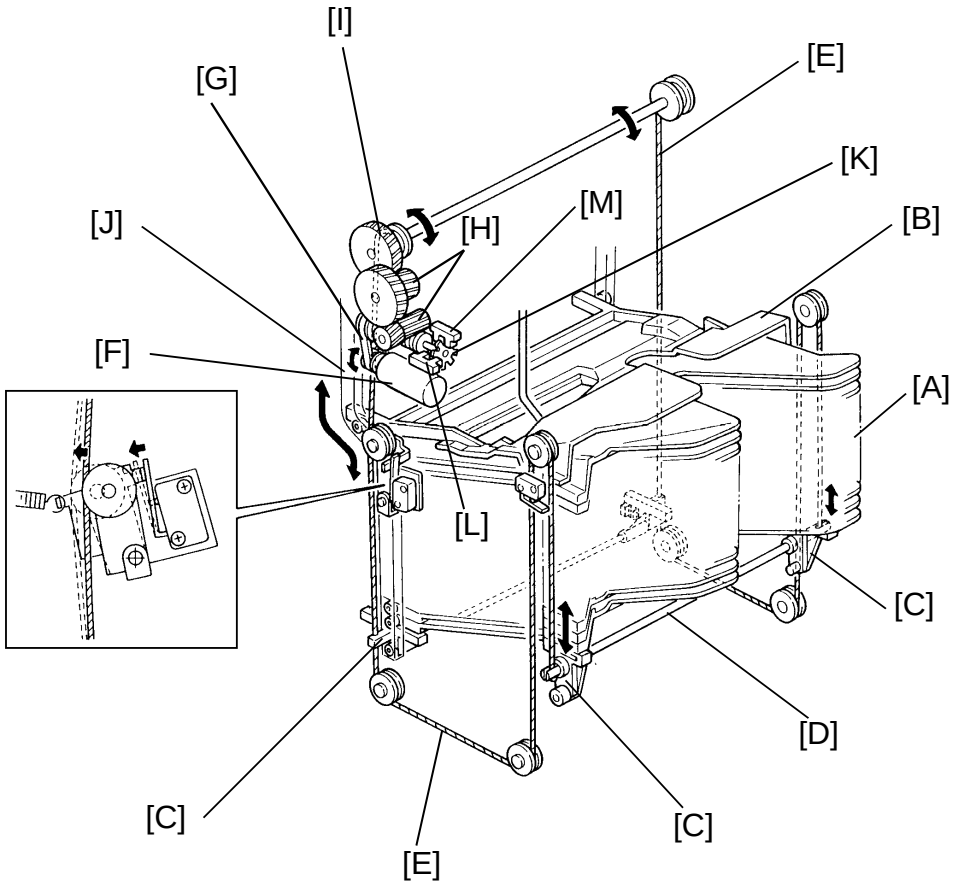
To feed copies out as fast as possible, the S/S CPU controls two motor rotation speeds.

The normal speed depends on the copier's paper transport speed. The S/S's paper transport speed is almost the same as but slightly faster than the copier's.

In the normal mode, the roller drive motor changes the paper transport speed from normal to high (500 mm/s, fixed) when the S/S CPU receives the paper exit signal from the copier. The roller drive motor changes the paper transport speed from high to normal 100 milliseconds after the proof tray exit sensor detects the trailing edge of the copy.

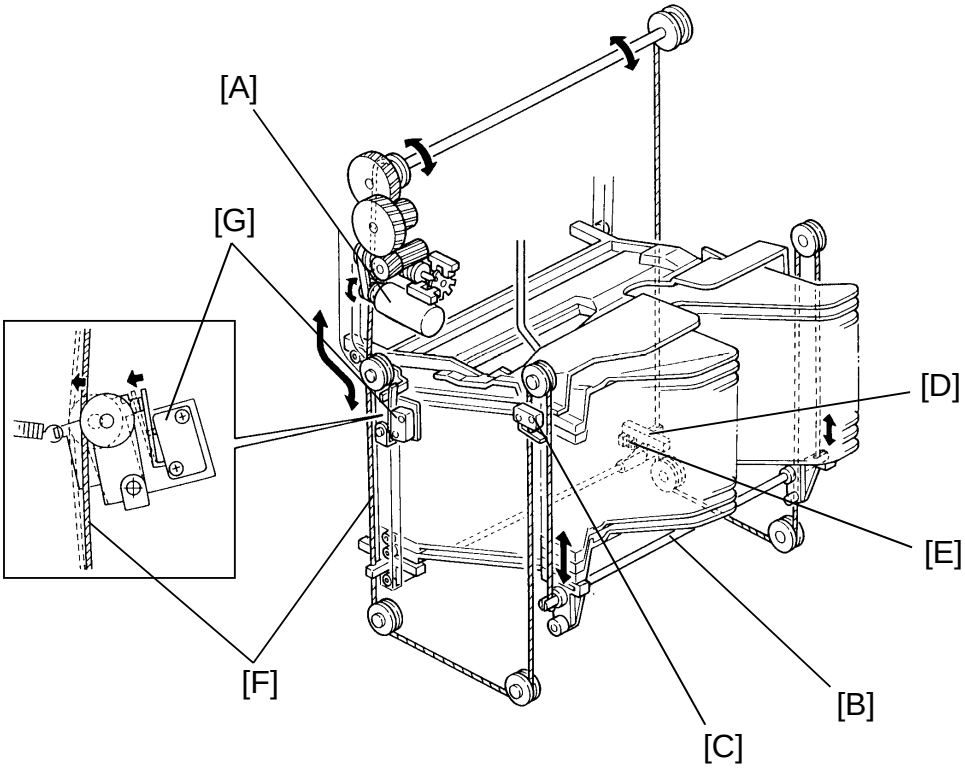
In the sort/stack/staple mode, the roller drive motor also changes the paper transport speed from normal to high and then from high to normal. The timing is the same as in the normal mode, but the bin exit sensor is used to detect the trailing edge instead of the proof tray exit sensor. The high speed is almost double the normal speed, and it changes depending on the paper size (900, 960, or 1,000 mm/second).

6. BIN DRIVE AND CONTROL



All the 20 bins [A] and the support bin [B] are piled up on the bin support blocks [C]. The front and rear bin support blocks are connected by the bin lift shafts [D], the ends of which are fixed to the bin lift wires [E] as shown. The bin lift motor [F] (dc motor) drives the bin lift wires through the bin lift drive belt [G], bin lift gears [H], and the bin lift gear/pulley [I]. Then the bins are driven up and down along the front and rear bin cam tracks [J].

The S/S CPU controls the amount of bin lift motor rotation by monitoring the pulses from the timing disc [K] through the bin lift timing sensors 1 and 2 [L and M]. Bin lift timing sensor 1 (blue connector) is used for counting the timing pulses. Bin lift timing sensor 2 (white connector) is used to determine the motor stop timing so that the edge of the timing disc slots is not positioned at timing sensor 1.



If the bin lift motor [A] fails to stop the bins at the highest position, the rear end of the left bin lift shaft [B] activates the upper lift limit switch [C] (which is a normally-closed type) to open the 24 Vdc line to the bin lift motor.

The front right bin support block [D] has an actuator on its underside. When all the bins are lowered and the first bin is positioned at the bin exit area, the actuator activates the bin home position sensor [E] and the bin lift motor turns off.

If the bin lift motor fails to stop lowering the bins at the bin home position, the rear bin lift wire [F] slackens. Then the wire tension switch [G] (which is a normally-open type) is deactivated, which opens the 24 Vdc line to the bin lift motor.

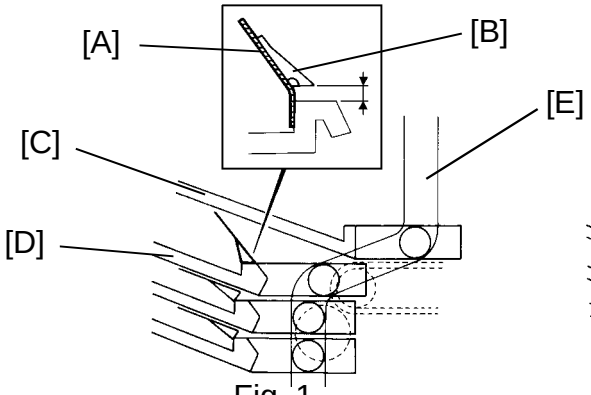


Fig. 1

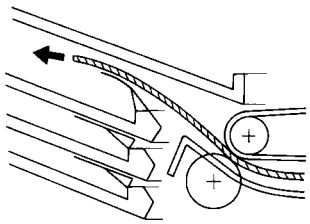


Fig. 2

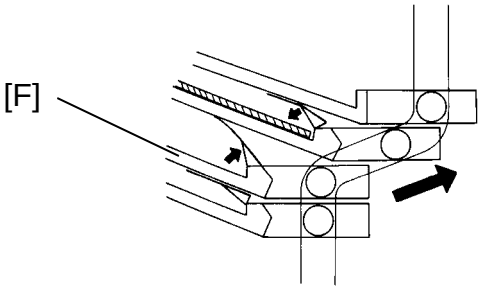


Fig. 3

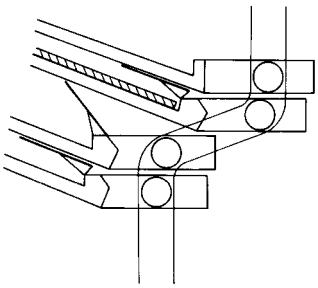


Fig. 4

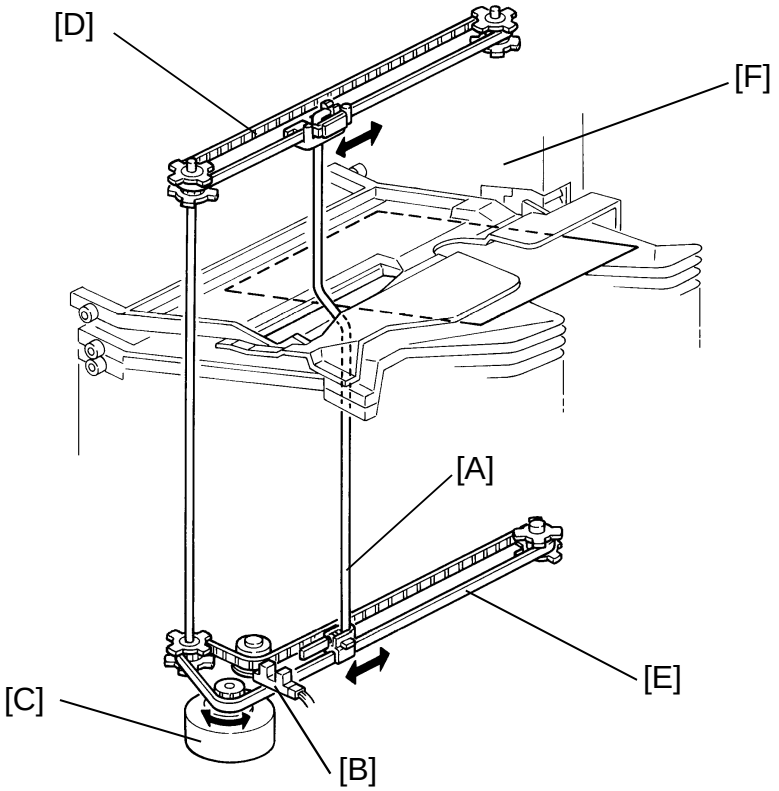
An end fence mylar [A] is attached to each bin entrance and an end fence block [B] is stuck on the mylar. These are attached with two-sided tape, as shown in figure 1. There is a twisted spring at the rear end of the bin entrance to raise the end fence block and mylar. When the bins are at the bin home position, the support bin [C] and the first bin [D] are positioned at the bend in the bin cam track [E] as shown. The support and first bins have a space between them so that the end fence mylar can fully rise until the end fence block stops it.

The space between the support and first bins is at the bin entrance section as shown in figure 2. Since the end fence mylar is thin, the copy exits to the first bin over the mylar. The steep angle of the bin helps the exited copy slide back due to its own weight under the mylar against the bin entrance.

When the bins move up along the bend of the bin cam track, the end fence mylar and block of the first bin are pushed down by the support bin, and those of the second bin [F] rise as shown in figure 3.

When the bin lift motor stops, the first and second bins are positioned as shown in figure 4. The lowered end fence mylar helps to prevent the copy in the first bin from moving out of the jogged position. The end fence mylar and block of the second bin are ready to receive the next copy.

7. JOGGER SECTION



When the Start key is pressed in the sort, stack, or staple mode, the copier sends the paper size information to the sorter stapler. When a copy enters the sorter stapler entrance, the jogger bar [A] stays at the home position which is detected by the jogger home position sensor [B].

At the appropriate time (depending on the selected paper size) after the trailing edge of the copy is detected by the bin exit sensor, the jogger motor [C] (a stepper motor) rotates forward and in reverse to move the jogger bar via the upper and lower jogger drive belts [D and E]. As the copy is fed out into the bin at the center, the jogger bar moves the copy all the way to the front, and pushes the paper side edge by 5 mm (0.2") against the front side plate [F]. Then the jogger bar moves back to the position which matches the paper width. Shortly after that, the jogger bar returns to its home position. This jogger bar movement is performed for each copy to square the copy stack.

In the automatic or manual staple modes, the jogger bar also moves to ensure that the stacked copies are squared before stapling. For how the jogger moves, see "Basic Operation - Staple Mode".

- Jogger off conditions -

1. Under the following conditions, the jogger bar does not jog after a copy is delivered to the bin.
    - If paper is loaded in a bin by hand while the sort/stack or staple mode is selected.
    - If the selected paper size does not match the stapling specifications.
    - If copies of different width are delivered to the bins.
2. If there is paper in a bin before the main switch is turned on, the sort/stack mode is disabled when the sorter key is pressed.

8. GRIP ASSEMBLY

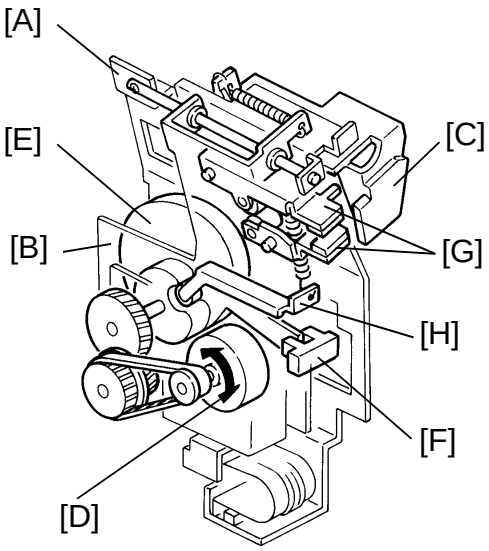


Fig. 1

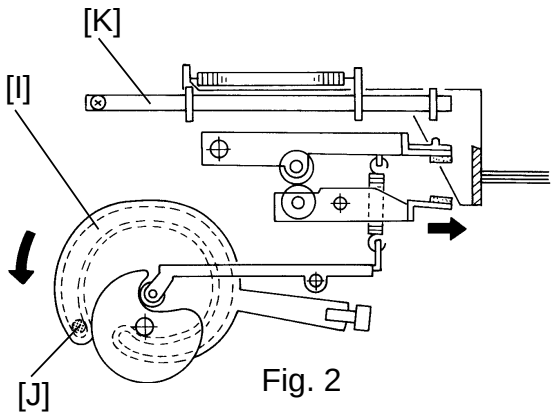


Fig. 2

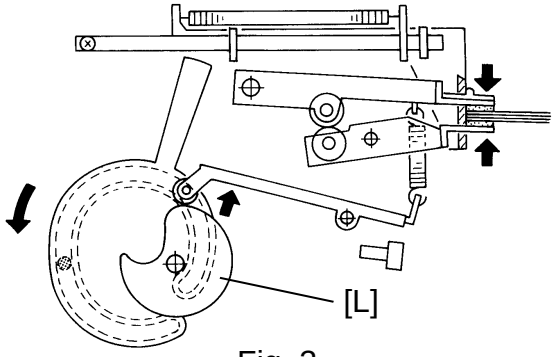


Fig. 3

Figure 1:
The grip assembly consists of the gripper guide bracket [A], the gripper assembly [B], and the bin side plate [C]. The major components of the gripper assembly are the grip motor [D] (a stepper motor), dual cam plate [E], grip home position sensor [F], grippers [G], and grip cam follower [H].

When the copier main switch is turned on, the grip motor rotates forward and/or reverses to position the whole gripper assembly at the home position. The home position is detected by the grip home position sensor and the sensor actuator on the dual cam plate.

Figure 2:
When the bin lift motor stops during the automatic or manual stapling cycle, the grip motor starts rotating. As the dual cam plate turns counter-clockwise, the cam groove [I] and the pin [J] on the gripper guide bracket move the whole gripper assembly along the gripper guide rod [K] into the bin.

Figure 3:
When the high lobe of the grip cam [L] (the small cam on the dual cam plate) pushes up the grip cam follower, the grippers close to grip the copies that are stacked in the bin.

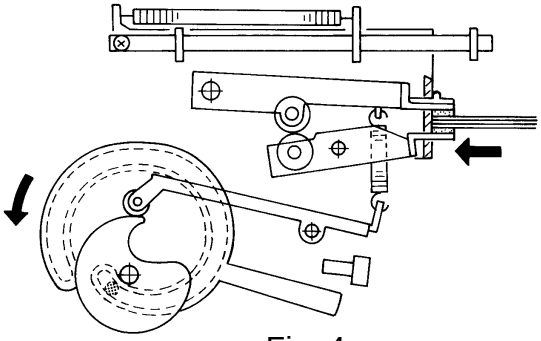


Fig. 4

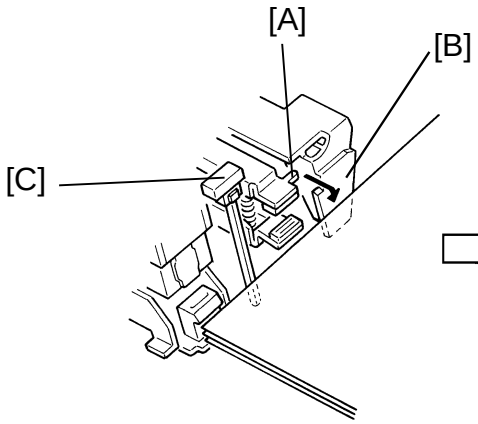


Fig. 5

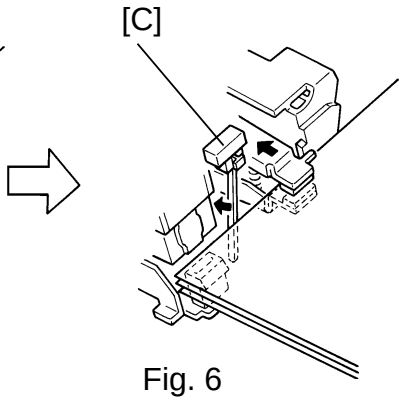


Fig. 6

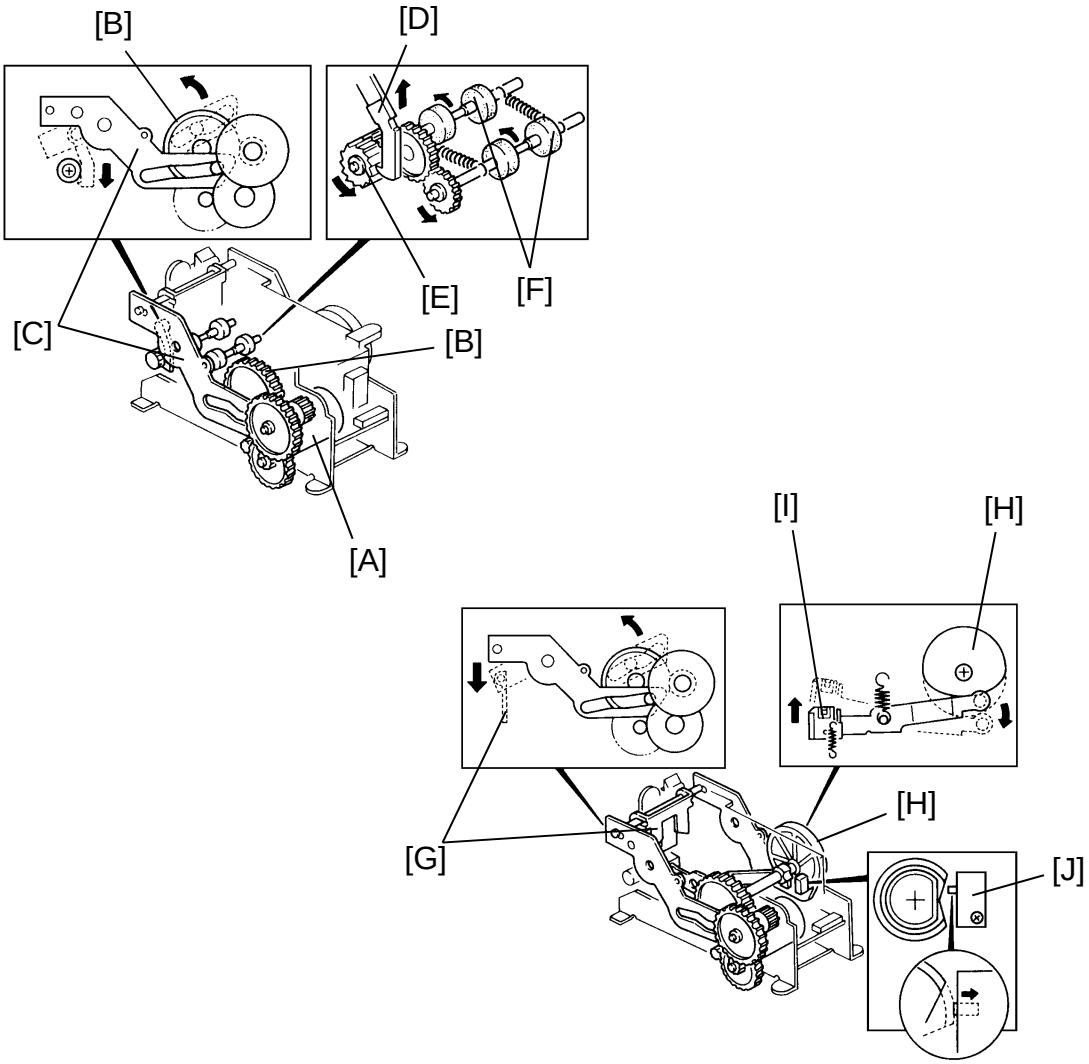
Figure 4:
As the dual cam plate rotates further, the cam groove and the pin move the whole gripper assembly with the gripped copies back to the stapling position. Then the grip motor stops.

Figure 5 and 6:
The upper gripper has a projection [A] for hooking the bin side plate [B]. When the gripper moves into the bin, the projection moves over the bin side plate. When the grippers close, the projection hooks the bin side plate. Therefore, the grippers bring the stacked copies into the stapler together with the bin side plate.

When the grippers move to the stapling position, the S/S CPU checks the paper sensor [C] to see if there is any paper there or not. If the paper sensor is activated, the stapler motor starts rotating and the copies are stapled.

When the stapler motor stops, the grip motor starts rotating in reverse. Then the gripper assembly brings back the stapled copies into the bin, the grippers open, and the gripper assembly returns to the home position.

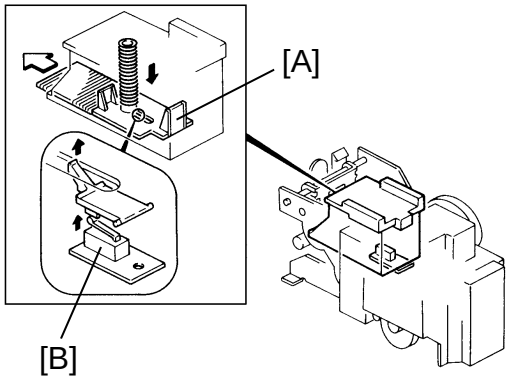
9. STAPLER

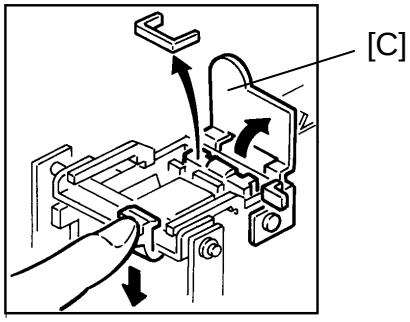


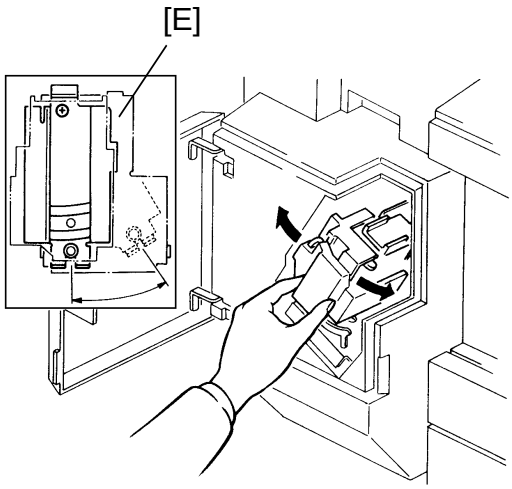
In automatic or manual stapling mode, the stapler motor [A] rotates when the grip motor stops rotating after the grippers bring the stacked copies to the stapling position.

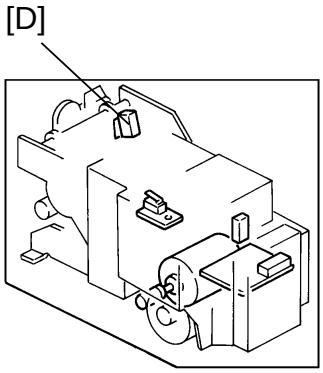
The staple gear [B] rotates counterclockwise, and the pin on the gear rotates the staple arm [C] counterclockwise, then clockwise. The ratchet [D] lowers and rises to rotate the ratchet wheel [E] counterclockwise. Then the staple feed rollers [F] turn via gears to feed a staple sheet to the hammer.

While both the front and rear staple arms rotate counterclockwise, the hammer [G] lowers. At the same time, the staple cam plate [H] lifts the clincher [I]. The hammer and the clincher staple the copies. Then, while the staple arms rotate clockwise, the hammer rises and the clincher lowers. When the staple home position switch (a normally-closed type) [J] is deactivated, the stapler motor stops.









When all the staple sheets are fed out of the staple cartridge, a notch cut out of the staple pressure plate [A] deactivates the staple end switch (a normally- closed type) [B]. The S/S CPU sends the staple end signal to the copier. After the stapling job is completed for all the bins, the Add Staples indicator lights on the copier operation panel and the Ready indicator turns off whenever the staple mode is selected.

Staple jams are easily cleared by opening the staple guide plate [C]. The staple guide switch (a normally-closed type) [D] detects whether the staple guide plate is closed or open. When the S/S front door and S/S unit itself are closed with the staple guide plate open, the Add Staples indicator lights on the copier operation panel.

The stapler can be swung on the stapler support bracket [E] and it has two lock positions. One is for horizontal stapling and the other is for diagonal stapling (at 25 degrees).

- Stapler inoperative conditions -

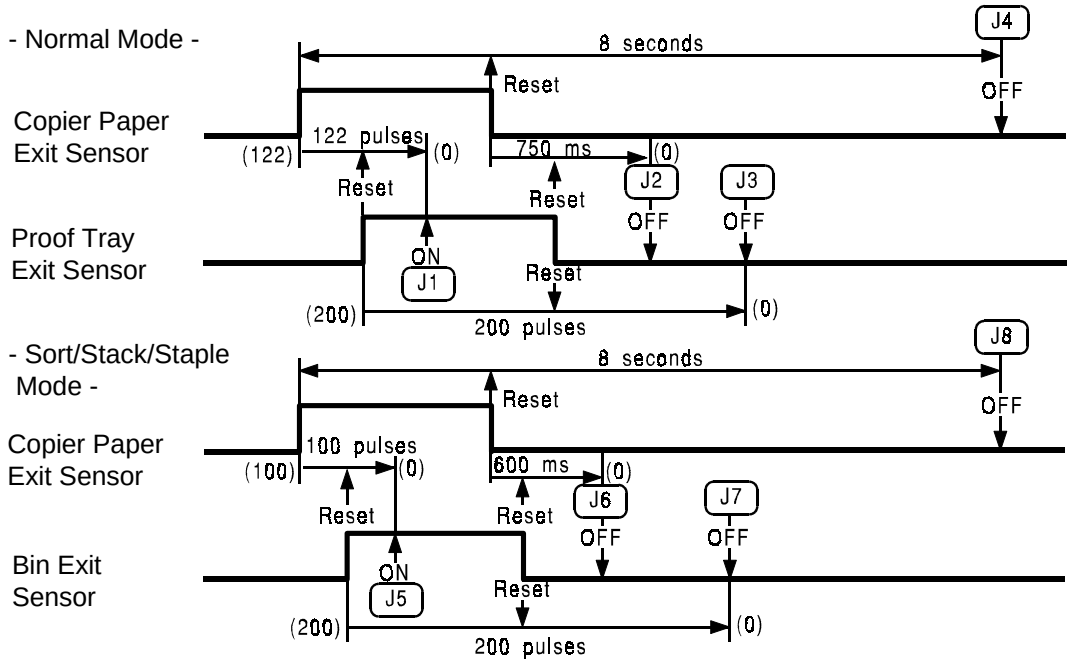
1. Under the following conditions, the staple mode is inoperative when the staple key on the operation panel is pressed.
   - If there is paper in a bin before the main switch is turned on.
   - If the selected paper size does not match the stapling specifications.

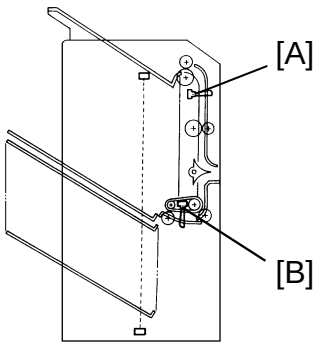
2. Under the following conditions, the staple mode is canceled.
   - If paper is loaded into a bin by hand while staple mode is selected.
   - If only one copy is delivered to the bin.
   - If the jogger operation has not been performed.
   - If some already-stapled copies are present in the bins.
   - If the number of sheets delivered to the bin exceeds the stapler capacity.
     Stapler capacity: 2 to 20 sheets for A4, B5, and 8 1/2" x 11"
     2 to 10 sheets for B4, A3, 8 1/2" x 14", and 11" x 17"
     The stapler capacity can be increased by 5 for both paper size types by changing the SP mode setting for the Stapling Limit. (If this is done, the stapling function is not guaranteed.)

3. Under the following conditions, manual stapling mode in sort mode is inoperative.
   - If paper is loaded into a bin by hand while sort mode is selected.
   - If the paper size in the bin does not match the stapling specifications.
   - If only one copy is delivered to the bin.
   - If copies of different width are delivered to the bin.
   - If some already-stapled copies are present in the bin.

10. JAM DETECTION AND STAPLER ERROR

10.1 SORTER JAMS





The sorter stapler main control board detects paper jams in the sorter stapler, or between the sorter stapler and the copier. To detect jams, the S/S CPU uses the paper exit on/off signal from the copier, and the proof tray exit sensor [A] (in normal mode) or the bin exit sensor [B] (in sort/stack/staple mode).

Jam check timing in normal and in sort/stack/staple modes is shown above. There are two time scales: one in seconds and milliseconds, and one in pulses. The pulses are the timing pulses from the roller drive timing sensor. Since the paper transport speed of the sorter stapler (this is the normal speed mode) depends on that of the copier, the sorter stapler cannot operate on a fixed time scale. Therefore, to match the sorter stapler speed to the copier's, the copier sends a signal to the S/S CPU; this controls the normal speed of the roller drive motor (the speed in high speed mode never changes) and this generates the pulse rate.

If the proof tray exit sensor or the bin exit sensor is actuated when the sorter stapler unit or the front door is opened and closed, or when the main switch is turned on, a sorter jam signal is sent to the copier.

Sorter jam conditions are reset by opening and closing the sorter stapler unit or the front door after clearing the jammed paper.

When an abnormal condition of the main motor, bin lift motor, or jogger motor is detected for the first time, the copier's operation panel will indicate a sorter jam. When the abnormal condition is detected for the second time, the S/S CPU sends an error signal to the copier. The copier's operation panel will indicate a service call code.

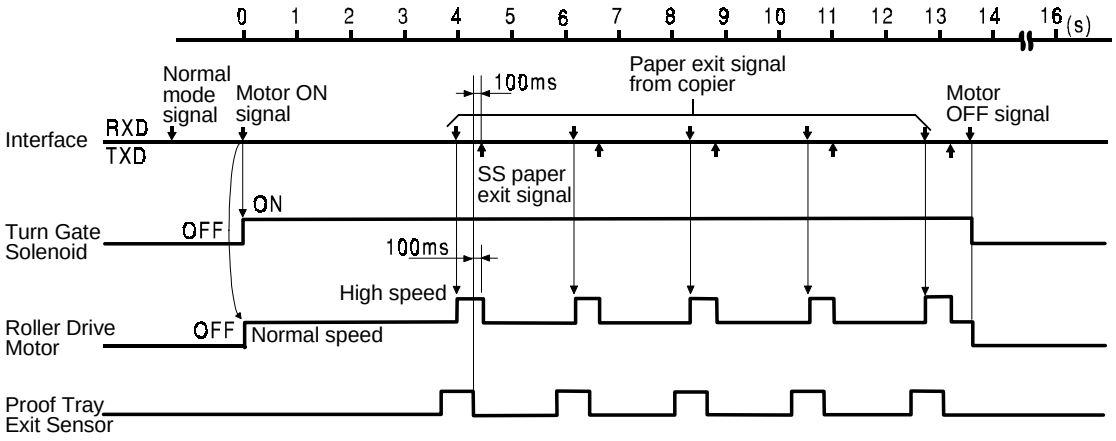
10.2 STAPLER ERROR

The sorter stapler main control board detects a stapler error when the following conditions are detected. The copier's operation panel will indicate a sorter jam, and stapling will stop in these cases.

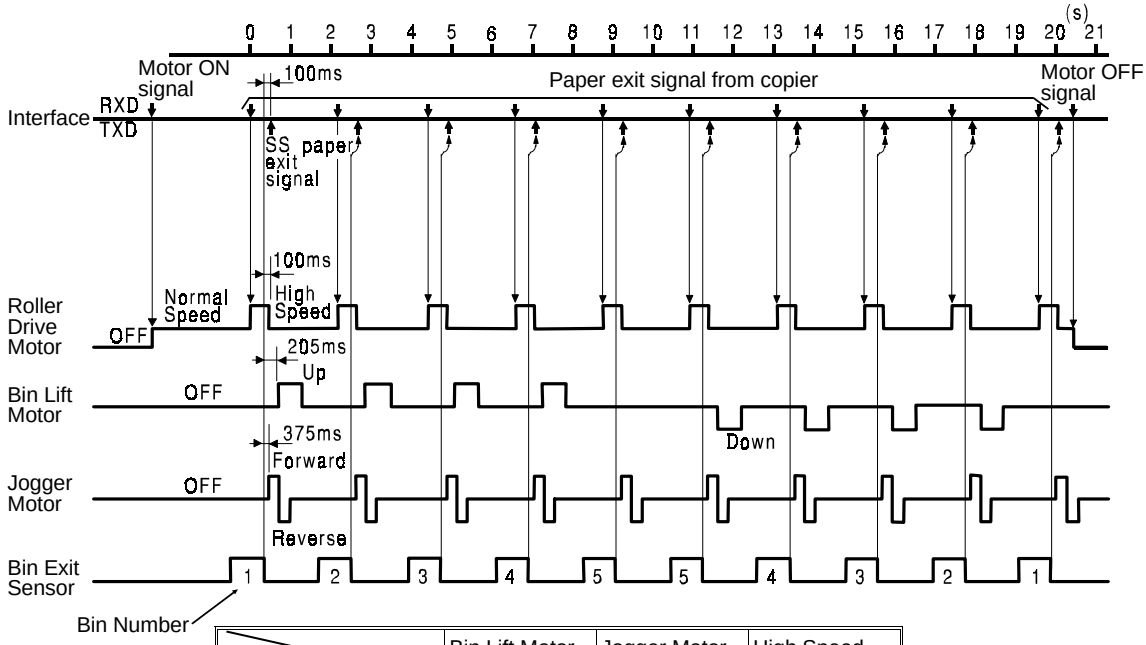
- If the paper sensor is actuated when the sorter stapler or the front door is opened or closed, or when the main switch is turned on.
- If the paper sensor is actuated when the grip assembly returns to the home position after the stapling operation.
- The first time an abnormal condition of the stapler motor or grip motor is detected.
  The second time an abnormal condition is detected, the copier's operation panel will indicate a service call code.

11. TIMING CHARTS

Timing Chart 1: Normal Mode (A4 sideways, 5 copies)

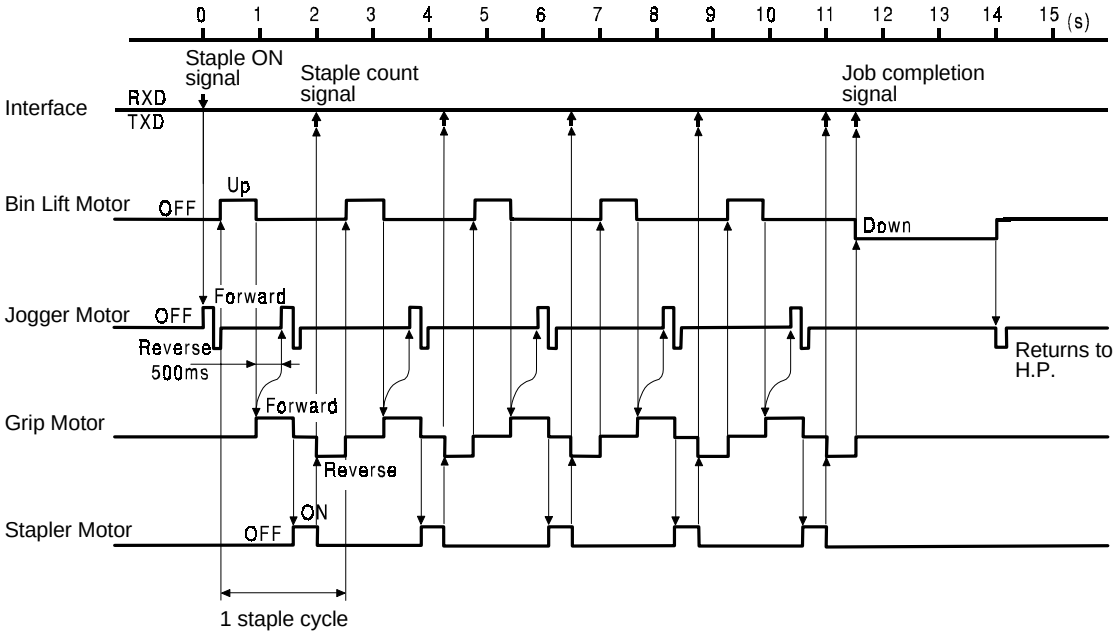


Timing Chart 2: Sort Mode (A4 sideways, 2 copies for 5 bins)



Paper Size	Bin Lift Motor ON Timing	Jogger Motor ON Timing	High Speed (mm/s)
A3	350 ms	190 ms	900
B4	350 ms	160 ms	900
A4 sideways	205 ms	375 ms	960
A4 lengthwise	610 ms	0 ms	900
B5 sideways	150 ms	370 ms	900
B5 lengthwise	230 ms	0 ms	900
11" x 17"	295 ms	130 ms	900
8 1/2" x 14"	675 ms	90 ms	900
8 1/2" x 11" sideways	130 ms	265 ms	960
8 1/2" x 11" lengthwise	625 ms	0 ms	900

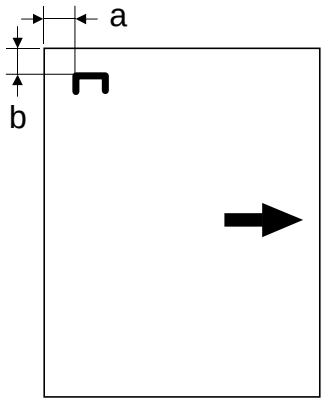
Timing Chart 3: Stapling (A4 sideways, 2 copies for 5 bins)



SORTER STAPLER A555

1. SPECIFICATIONS

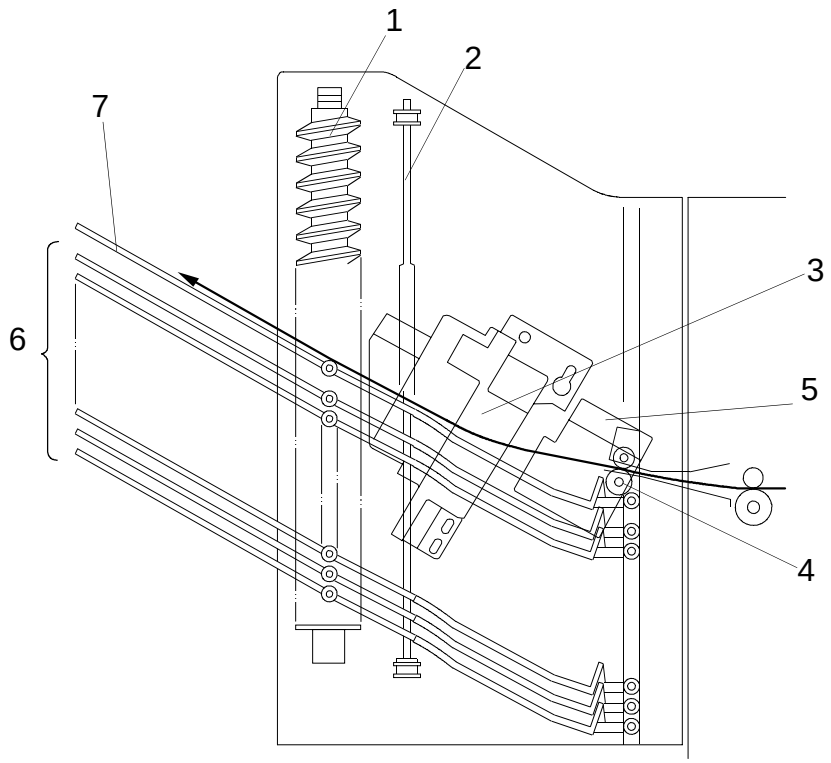
Paper Size for Bins:	Sort/Stack Modes: Maximum: A3, 11 x 17" Minimum: B5, 8 1/2 x 11"
Paper Weight for Bins:	Sorting: 52 ~ 157 g/m^2 (14 ~ 42 lb) Stacking: 52 ~ 157 g/m^2 (14 ~ 42 lb) Stapling: 52 ~ 80 g/m^2 (14 ~ 21 lb)
Bin Capacity:	Sorting: A4, 8 1/2 x 11" or smaller: 30 copies B4, 8 1/2 x 14" or larger: 25 copies Stacking: A4, 8 1/2 x 11" or smaller: 25 copies B4, 8 1/2 x 14" or larger: 20 copies
Stapler Capacity:	2 ~ 20 copies
Proof Tray Capacity:	100 copies (52 ~ 80 g/m^2 / 14 ~ 21 lb) 50 copies (81 ~ 128 g/m^2 / 22 ~ 34 lb) 30 copies (129 ~ 157 g/m^2 / 35 ~ 42 lb)
Number of Bins:	10 bins + proof tray
Stapling Position:	a = 6 ± 3 mm b = 6 ± 3 mm



Staple Replenishment:	Cartridge exchange (2,000 staples/cartridge)
Power Source:	DC 24V, 5V (from the copier)
Power Consumption:	Average: less than 33 W Average for Sorting: less than 25 W Average for Stapling: less than 33 W
Weight:	12.4 kg (27.4 lb)
Dimensions (W x D x H):	381 x 548 x 443 mm (15.0" x 21.6" x 17.5")

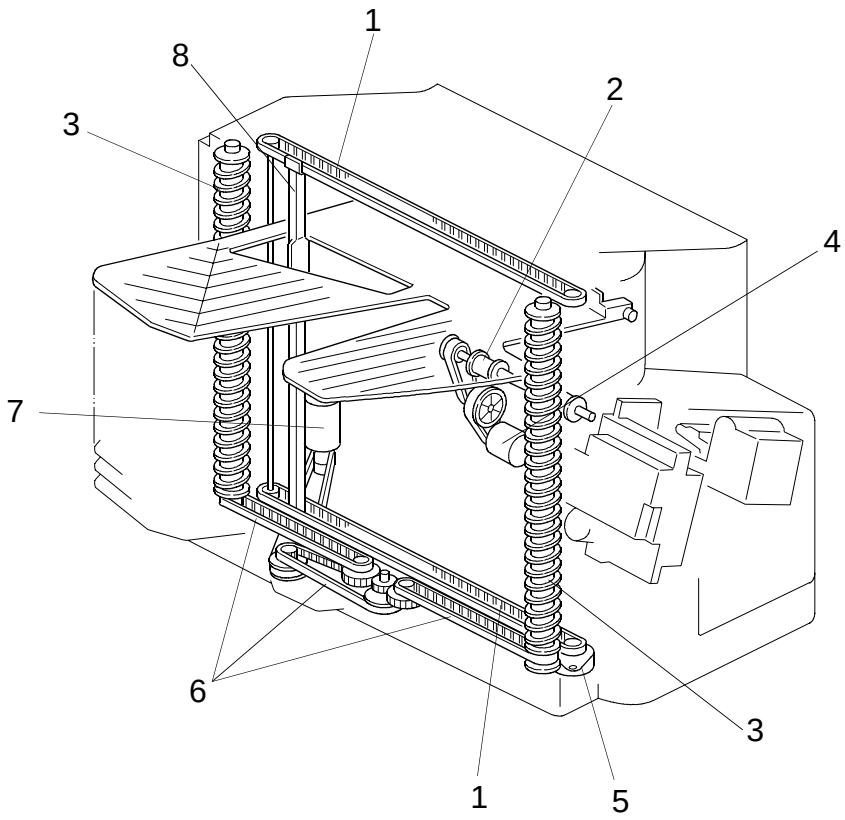
2. COMPONENT LAYOUT

2.1 MECHANICAL COMPONENT LAYOUT



1. Helical Wheels
2. Jogger Plate
3. Grip Assembly
4. Transport Rollers
5. Staple Unit
6. Bins
7. Proof Tray

2.2 DRIVE LAYOUT



1. Jogger Drive Belt
2. Transport Roller
3. Helical Wheels
4. Transport Motor
5. Jogger Motor
6. Wheel Drive Belts
7. Bin Drive Motor
8. Jogger Plate

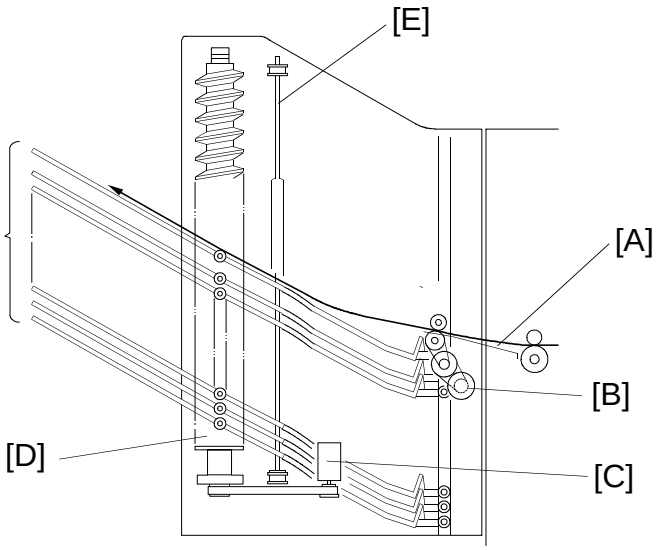
2.3 ELECTRICAL COMPONENT DESCRIPTION

Refer to the electrical component layout on the reverse side of the Point to Point Diagram (on waterproof paper).

Symbol	Index No.	Description	Note
Motors			
M1	14	Transport	Drives the transport roller
M2	9	Jogger	Drives the jogger plate to square the copies
M3	16	Bin Drive	Drives the bins
M4	6	Stapler	Drives the stapler hammer
M5	3	Grip	Drives the grippers forwards and back into the bin to grip the copies and bring them to the stapling position
Sensors			
S1	1	Bin (Phototransistor)	Detects whether there is any paper in the bins (light receiving element)
S2	2	Sorter Entrance	Detects paper jams
S3	15	Jogger H.P.	Detects whether the jogger plate is in its home position
S4	13	Timing	Provides pulses to the sorter stapler main board.
S5	4	Stapler Paper	Detects whether any copies are under the hammer.
S6	5	Grip H.P.	Detects when the grip assembly cam gear has rotated once
S7	11	Bin (LED)	Detects whether there is paper in the bins (light emitting element)
S8	10	Wheel	Detects the bin position.
S9	12	Bin H.P.	Detects whether the bins are at home position
S10	18	Staple H.P.	Detects whether the stapler hammer is at home position
S11	19	Staple End	Detects when the staples run out
Switches			
SW1	8	Door Safety	Cuts the dc +24V supply when either the unit or the stapler cover is opened.
SW2	7	Stapler	Cuts the signals to the stapler.
Circuit Board			
PCB1	17	Main	Controls all sorter/stapler functions

3. BASIC OPERATION

3.1 NORMAL MODE AND SORT/STACK MODE



Copies exiting the copier pass through the entrance guide plate [A]. The transport roller will send copies either to the proof tray or to each bin, depending on the selected mode.

During copying, all rollers in the sorter stapler transport the paper at a speed which depends on the copier. When the trailing edge of the copy passes the fusing exit sensor, the speed of the rollers changes to 600 mm/s. This makes enough time for the jogger plate to square the stack of paper and to stack the paper smoothly into the bins.

- Normal (proof) mode -

When the Start key is pressed, the transport motor [B] energizes to rotate the transport roller. The transport roller sends copies to the proof tray directly.

- Sort mode -

When sort mode is selected, the bin drive motor [C] energizes to rotate the helical wheels. The helical wheels [D] rotate twice to move the top bin to the transport roller position, then the first copy is delivered to the top bin.

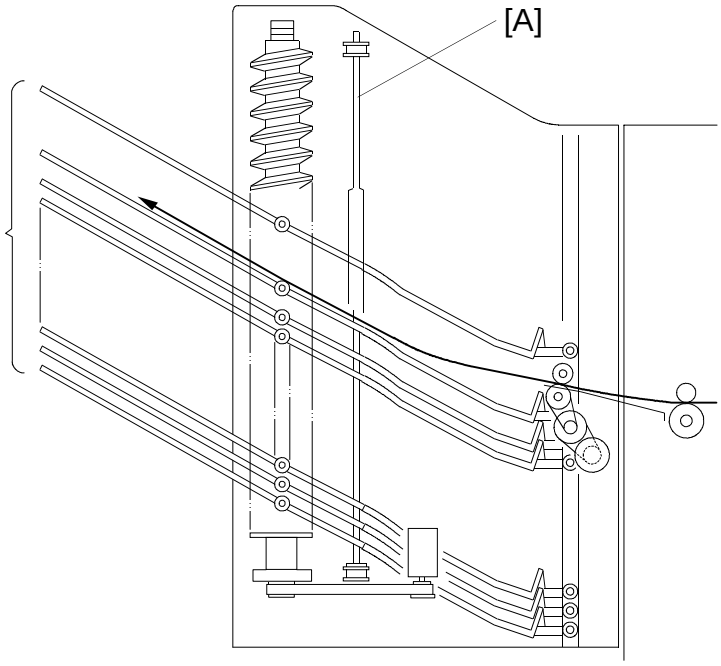
After the first copy of the first original has been fed to the top bin, the bin drive motor moves the bins up one step (the helical wheels rotate once) so that the second copy of the first original will be delivered to the next bin.

The jogger plate [E] squares the copies after each copy has been fed to a bin. After the copies of the first original have been delivered to each bin, the sorter stapler maintains its status (the bin drive motor does not rotate).

The first copy of the second original is delivered to the final bin that was used for the first original, then the final bin descends one step. The bins descend each time a copy of the second original is delivered.

The direction of motion of the bins alternates for each page of the original until the copy run is finished.

- Stack mode -

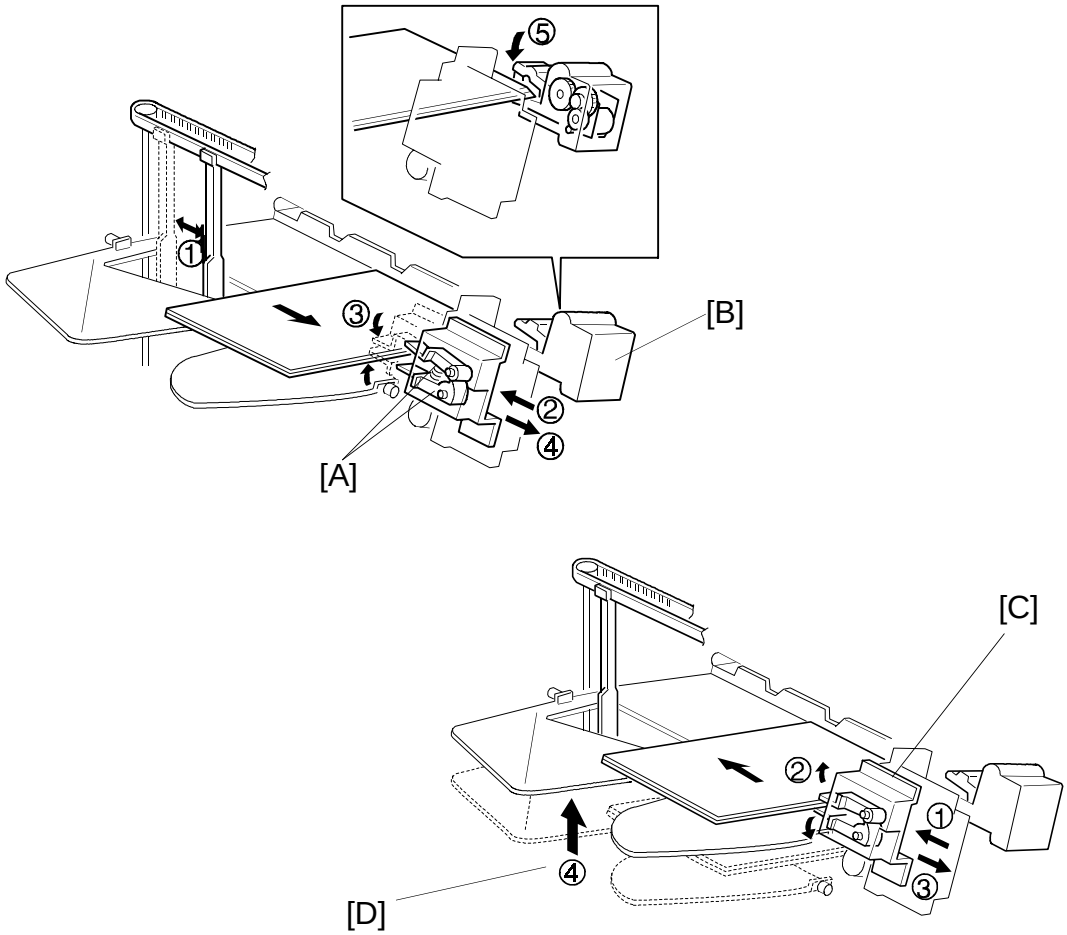


When stack mode is selected, the top bin advances to the transport roller position in the same way as in sort mode.

After the first copy is delivered to the top bin, the jogger plate [A] moves across to square the copy. The jogger plate squares the copies after each copy has been fed to a bin.

After one set of copies for the first original has been delivered to the top bin, the bin drive motor moves the bins up one step. Then, one set of copies of the second original will be delivered to the next bin.

3.2 STAPLE MODE



The stapler is only available in sort mode.

When the jogger plate has squared the final set of copies, the grip arms [A] move inside the front side frame and catch the paper. The grip assembly brings the copies into the stapler [B], and the stapler staples the copies.

After stapling, the grip assembly [C] brings the stapled copies back to the bin and releases the copies. Then the grip assembly goes back to the normal position. The bin either advances or descends one step depending on whether the number of originals is odd or even [D].

When the final set of copies has been stapled, the bins go back to the standby position.

There are two staple modes.

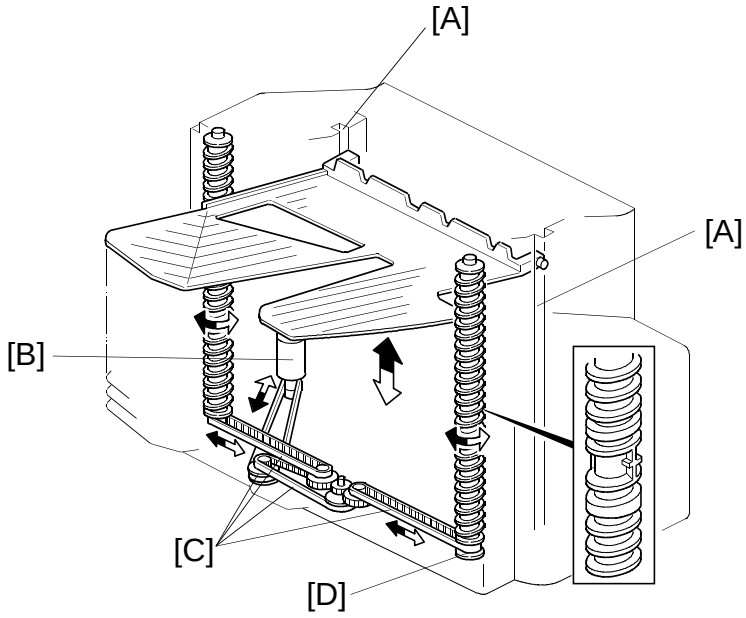
Automatic Stapling

In ADF mode, when staple mode is selected before pressing the Start key, copies will be delivered to each bin and stapled automatically.

Manual Stapling

In platen cover mode, after the copies have been sorted into the bins, the staple mode LED starts to blink. If the sort key is pressed while this LED is blinking, the copies will be stapled.

3.3 BIN DRIVE MECHANISM



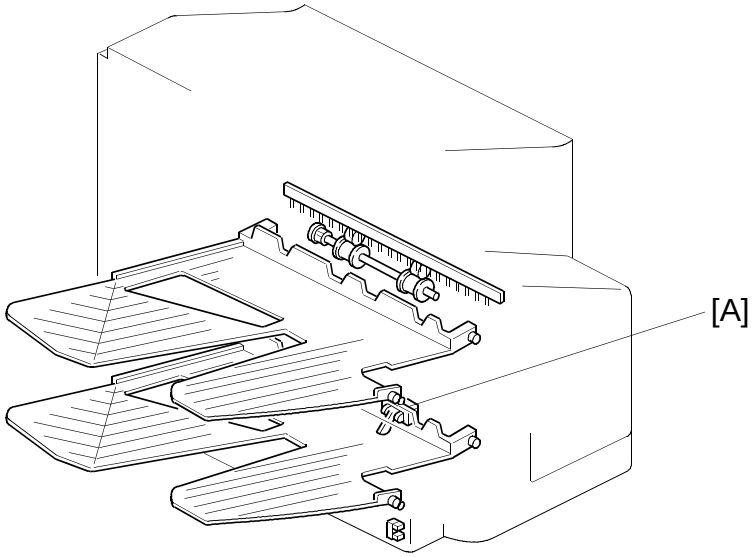
The bin drive mechanism moves the bins up and down to receive copies.

There are four pins on each bin. Two pins fit into the slots [A] in both the front and rear side frames; the pins slide up and down in these slots. The other two pins fit into the slot in the helical wheels; as the helical wheels turn, these pins move up and down, and the other pins move up and down in the slots at the other end of the bin.

The bin drive motor [B] drives the helical wheels through four timing belts [C]. When the motor rotates clockwise, the bins lift; when it rotates counterclockwise, the bins lower. There is a wheel sensor actuator [D] on the front helical wheel; the actuator has a slot which detects when the helical wheel has rotated once.

When the bins are advanced, the helical wheels rotate once for each step. As the pitch of the spiral on the helical wheel is greater when the bins are at the staple and paper exit area than when the bins are elsewhere, the amount of bin shift is greater when the bins are at the staple and paper exit area. This leaves enough space to staple and stack the copies. Also, this reduces the total machine height.

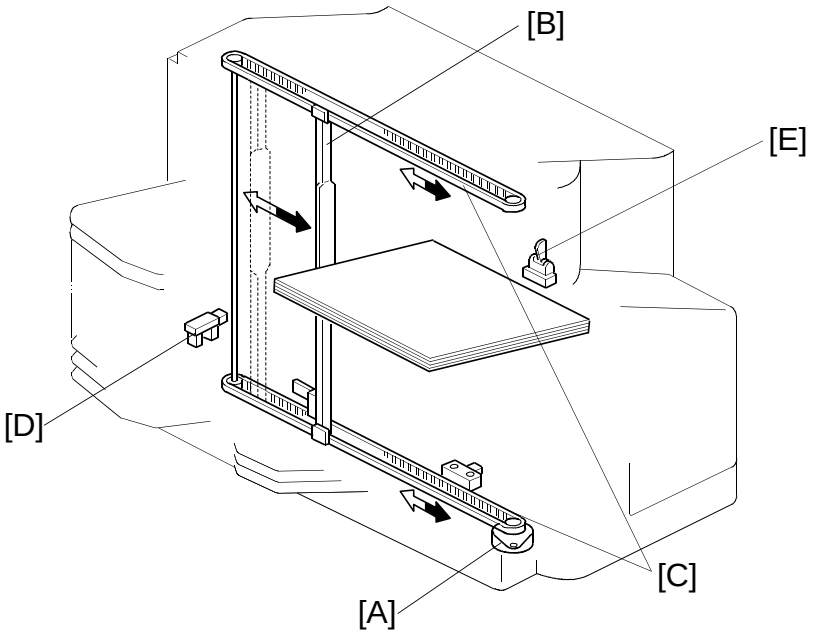
3.4 BIN HOME POSITION



The bin home position sensor [A] ensures that the proof tray is lower than the transport roller when the bins are in the home position.

When the main switch is turned on, the sorter stapler initializes itself to check whether the component parts work or not. At this time, the bin drive motor raises the bins for a few moments, then it lowers the bins until the bottom bin actuates the bin home position sensor.

3.5 JOGGER MECHANISM



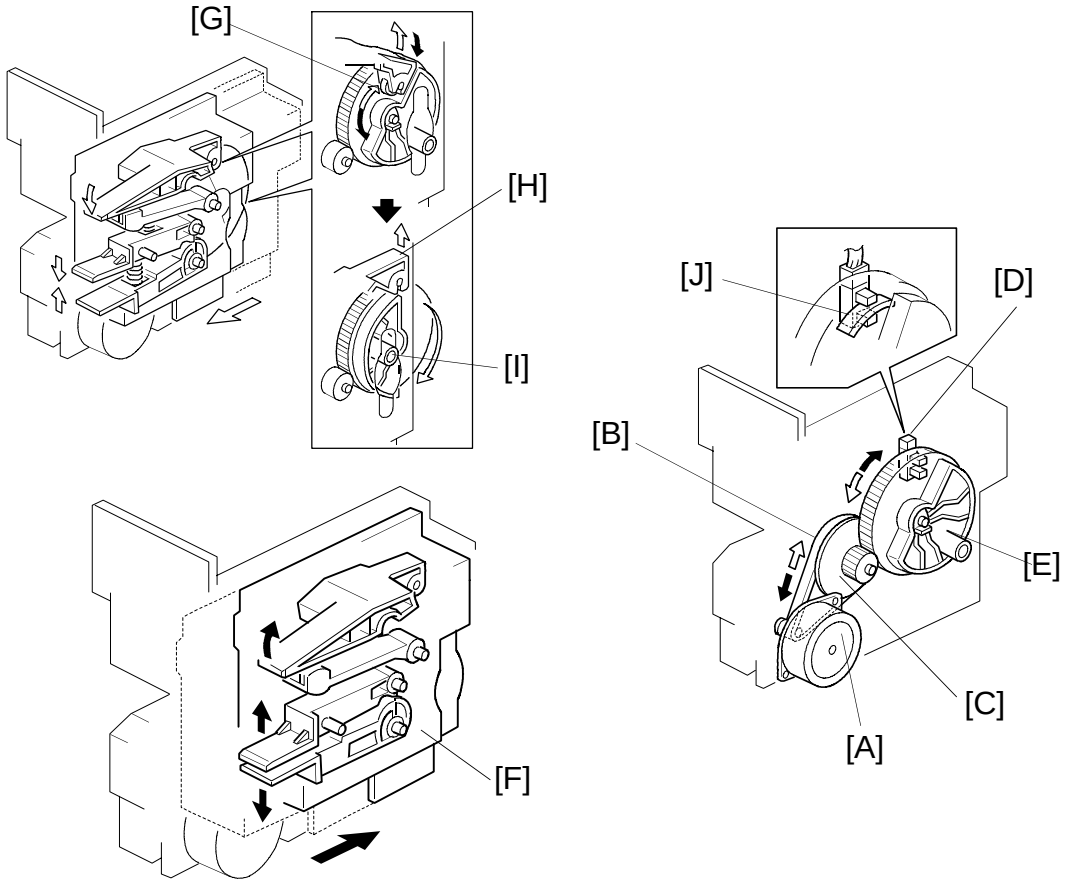
The jogger motor [A] drives the jogger plate [B] through the timing belts [C].

The jogger is at home position when the actuator on the jogger plate goes into the jogger home position sensor [D].

At standby, the jogger plate is at the home position. When the Start key is pressed, the copier sends the paper size information to the sorter stapler.

In sort, staple, and stack modes, the jogger moves three times to square the stack of paper. First, when the paper has been fed completely into the bin (at the proper time after the copy has passed through the entrance sensor [E], depending on the paper length), the jogger motor moves the jogger plate out of the jogger home position. Then, the jogger motor drives the jogger plate to the width of the copy. Finally, the jogger plate moves inward to push all the copies against the front side frame, which squares the sheets of paper. Then the jogger plate returns to the home position.

3.6 GRIP ASSEMBLY



The grip assembly consists of the grip motor [A], the timing belt [B], the drive gear [C], the grip home position sensor [D], and the cam gear [E].

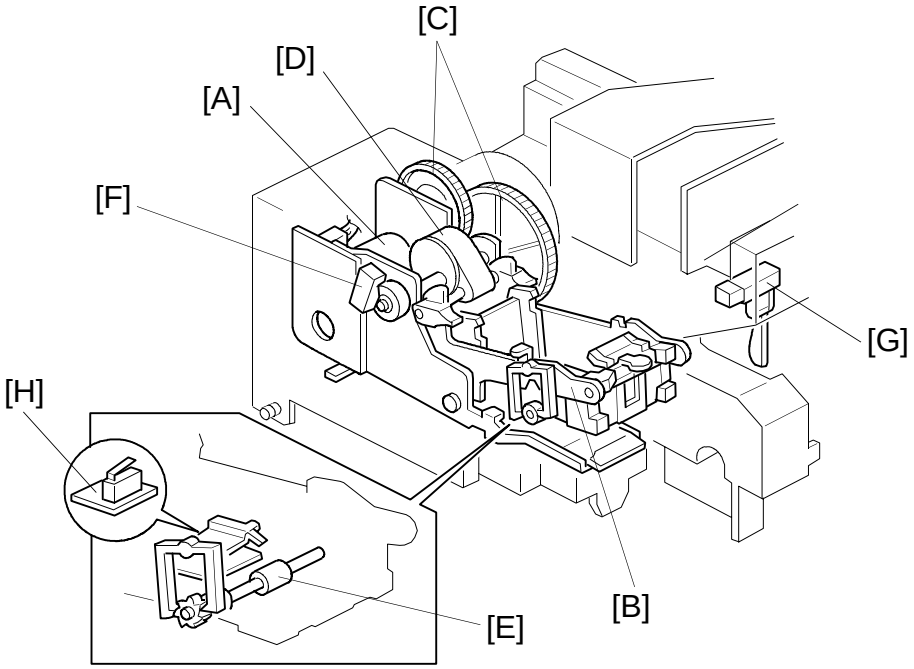
The grip motor drives the cam gear through the timing belt and drive gear. Cam gear rotation drives the mechanism that catches the copies and moves the grip arm unit [F]. When the cam gear rotates clockwise one full turn, the grip arm moves to catch the copies and returns to the home position to prepare for stapling. After stapling, the cam gear rotates counterclockwise once so that the stapled copies go back to the bin, and the cam gear returns to its home position.

When the cam pushes the roller [G] on the lever [H] and the lever pushes the grip arm, the grip arm can catch the copies.

A pin [I] on the cam gear fits into the slot in the grip arm unit. So, when the cam gear rotates, the slot moves the grip arm unit inward and outward.

The actuator [J] on the cam gear activates the grip home position sensor once every rotation of the cam gear. This allows the sorter stapler to determine that the cam gear has rotated once.

3.7 STAPLER UNIT



The stapler motor [A] drives the staple hammer [B] using the gears [C] and the eccentric cam [D].

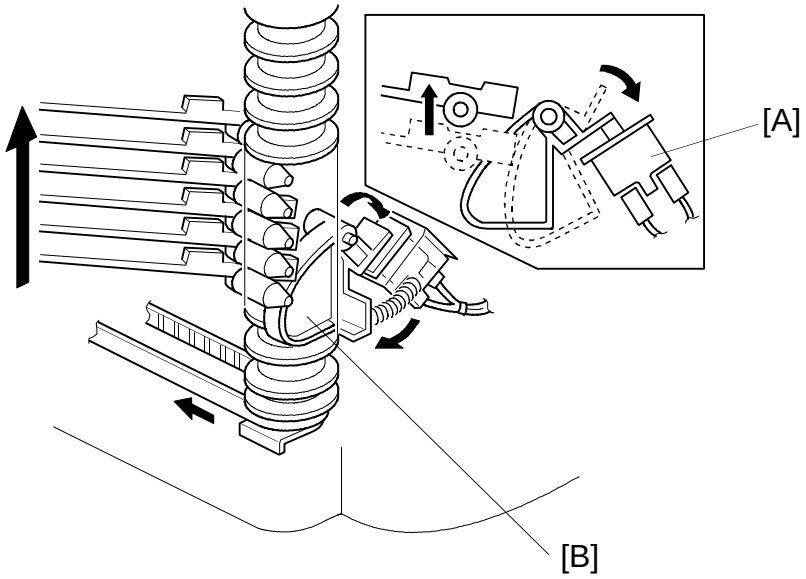
The roller [E] feeds the staple sheets under the hammer.

When the aligned copies are brought to the staple position by the grip unit, the stapler motor starts rotating and the copies are stapled. When the cam completes one rotation, the staple home position sensor [F] is deactuated and the stapler motor stops.

When the stapler paper sensor [G] in the grip assembly does not detect any copies under the hammer, the stapler motor does not rotate.

When the trailing edge of the last staple sheet pass through the staple end sensor [H], the sorter stapler enters the staple near end condition. After the current job is completed, the Add Staples indicator lights on the operation panel. Then the copier cannot be used whenever the staple mode is selected.

3.8 STAPLER SWITCH



The stapler switch [A] below the grip assembly cuts the signal to the stapler. In proof mode, all bins lower and push the lever [B]. This opens the stapler switch so that the signal to the stapler is cut. In sort and staple modes, all bins are advanced and the switch is closed so that the signal can be supplied to the stapler.

- Staple Disabling Conditions -

1. Under the following conditions, staple mode is disabled.

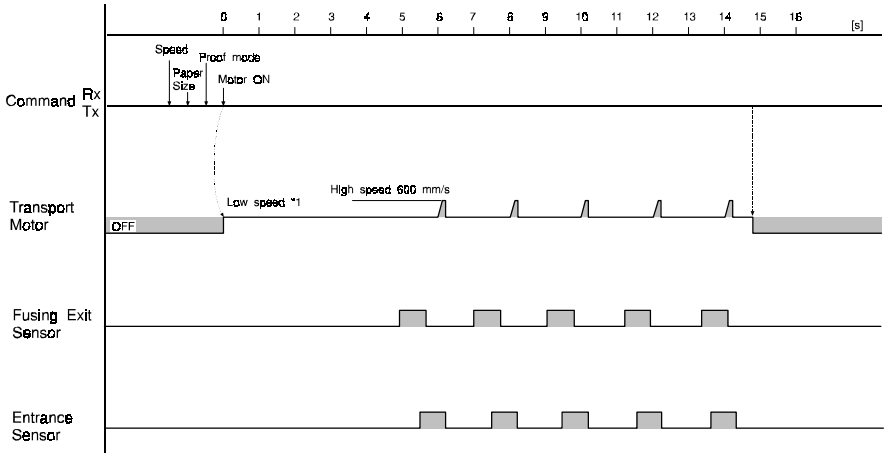
   If there is paper in a bin before the main switch is turned on.
   If the selected paper size does not match the stapling specifications.
   If the paper is fed from the by-pass feed table.
   If the stack or interrupt modes are selected.

2. Under the following conditions, staple mode is canceled if it had been selected.

   If paper is inserted into a bin by hand while the staple mode is selected.
   If only one sheet is delivered to the bin.
   If the number of sheets to be stapled exceeds the stapler capacity.

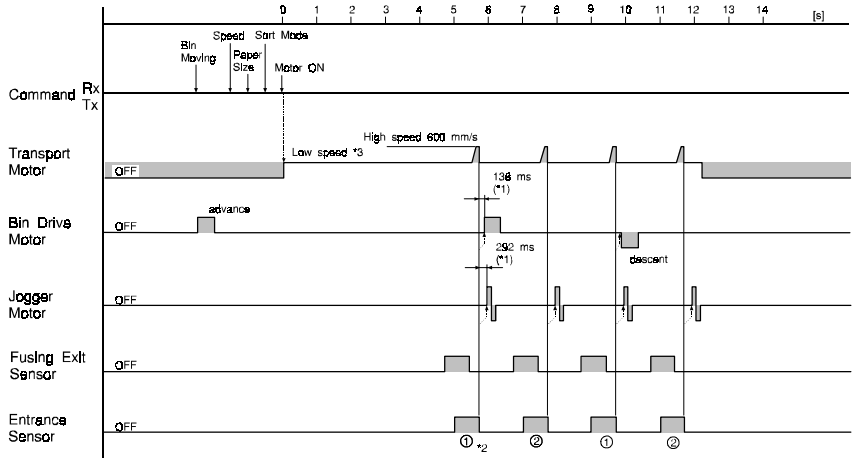
3.9 PAPER FEED AND MISFEED DETECTION TIMING

– Proof Mode – A4 sideways, 5 copies, 150 mm/s



*1: The value of the low speed depends on the copier.

– Sorter Mode – A4 sideways, two copies a of two-page original, 150 mm/s



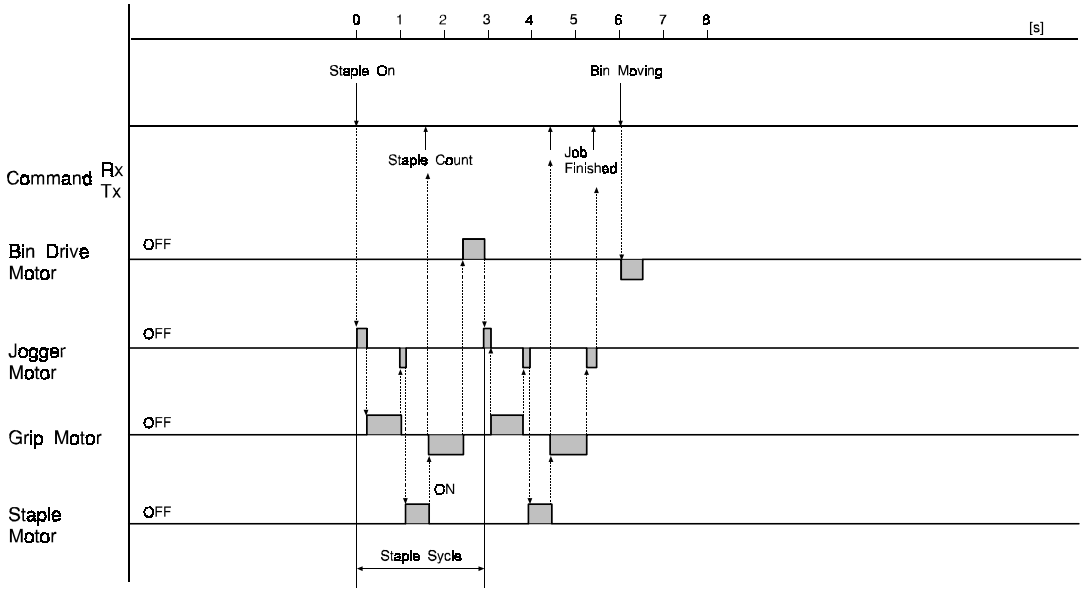
*1: The start timing of the bin drive and the jogger motors depend on the paper size as shown in the following table.

*2: Bin No.

Paper Size	Bin drive motor timing	Jogger motor timing	Paper Size	Bin drive motor timing	Jogger motor timing
A3/11"x17"	138 ms	292 ms	A4 lengthwise/ 8 1/2"x11"	312 ms	118 ms
B4	218 ms	212 ms	B5 sideways	218 ms	212 ms
A4 sideways/ 11"x8 1/2"	138 ms	292 ms	B5 lengthwise	368 ms	62 ms

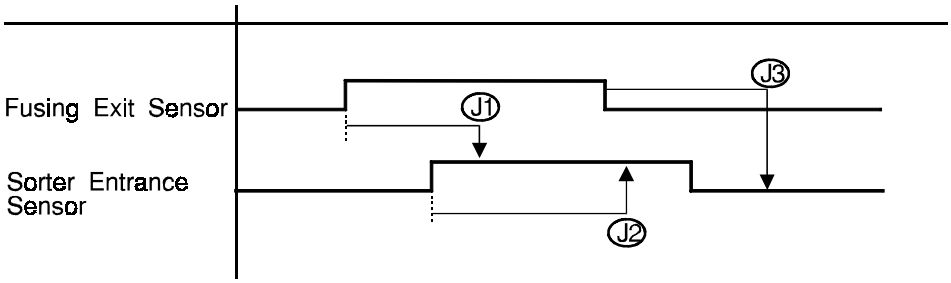
– Staple Mode –

A4 sideways, two copies of a two-page original, after sorting, 150 mm/s



3.10 JAM DETECTION

– Paper Jam –



J1: The sorter entrance sensor does not turn on within 2 s after the fusing exit sensor has turned on.

J2: The fusing exit sensor does not turn off within 11.4 s after the sorter entrance sensor has turned on.

J3: The sorter entrance sensor does not turn off within 1 s after the fusing exit sensor has turned off.

– Staple Jam –

In the following conditions, a staple jam will occur and the sorter jam indicator on the operation panel will light.

1. If the stapler paper sensor is on when the main switch turns on or just as the stapler cover is closed.
2. If the stapler paper sensor stays on after the stapling job has been finished.

SORTER A556

1. SPECIFICATIONS

Number of Bins: 20 bins + proof tray

Paper Size for Bins: Sort/Stack Mode:
Maximum - A3, 11" x 17"
Minimum - A5, 5 1/2" x 8 1/2"

Paper Weight: Sort/Stack Mode: 52 to 90 g/m^2 (14 to 24 lb)
Non-Sort/Stack Mode: 52 to 162 g/m^2 (14 to 43 lb)

Bin Capacity:

	Sort/Stack Mode (Bins 1 to 20)	Non-Sort/Stack Mode (Proof tray)
A4, 8 1/2" x 11" or less	30	100
B4, 8 1/2" x 14"	15/10	100
A3, 11" x 17"	10	100

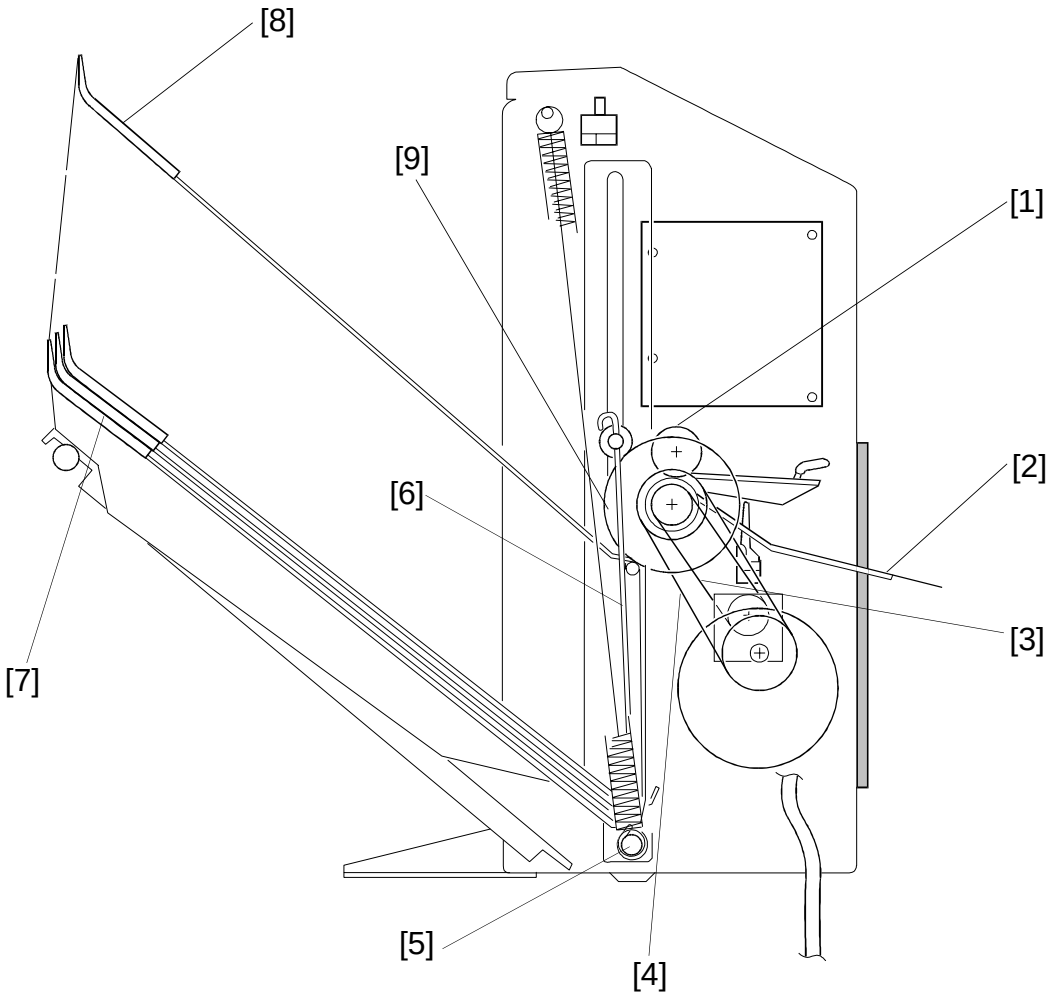
Power Source: +5 volts and +24 volts from the copier

Power Consumption: 24 W

Dimensions: 346 mm x 474 mm x 338 mm
(W x D x H) 13.6" x 18.7" x 13.3"

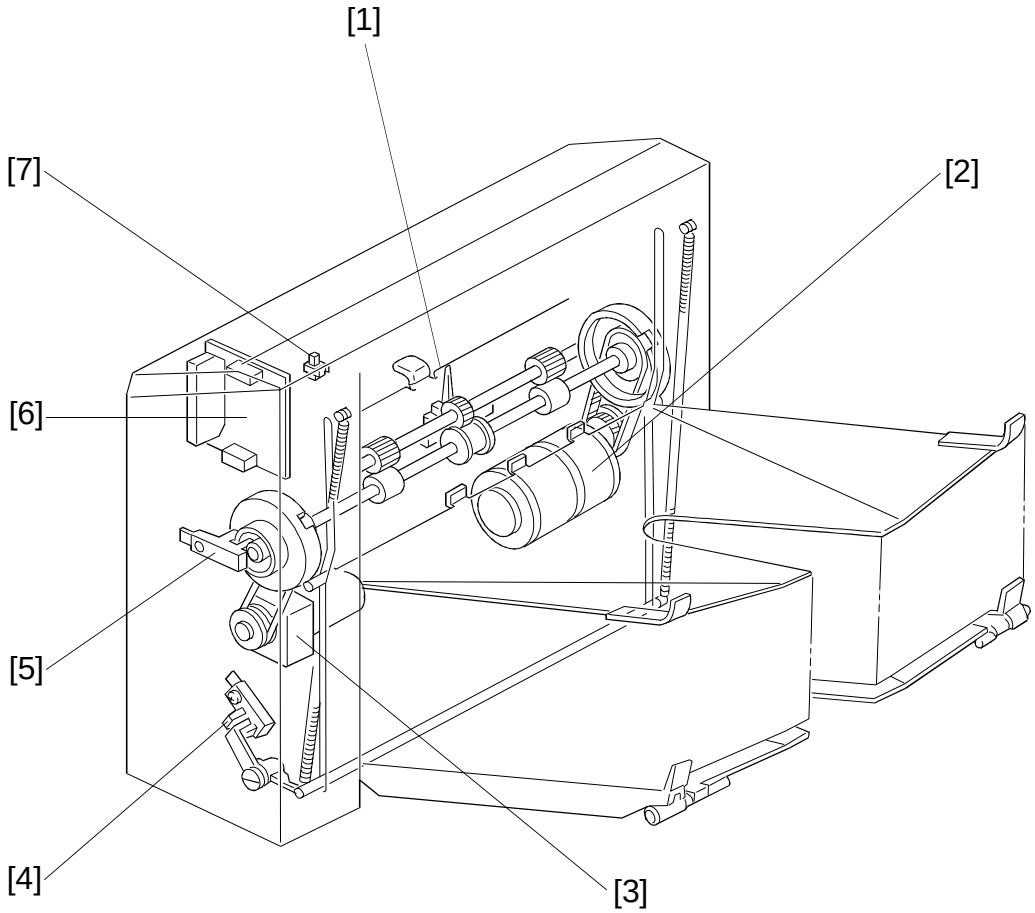
Weight: 12.5 kg (27.8 lb)

2. MECHANICAL COMPONENT LAYOUT



1. Exit Rollers
2. Paper Guide
3. Roller Drive Belt
4. Wheel Drive Belt
5. Lift Bar
6. Securing Wire
7. Bins
8. Proof Tray
9. Transfer Wheel

3. ELECTRICAL COMPONENT LAYOUT



1. Paper Sensor (S1)
2. Wheel Drive Motor (M1)
3. Roller Drive Motor (M2)
4. Bin Home Position Sensor (S2)
5. Wheel Sensor (S3)
6. Sorter Main Board (PCB1)
7. Cover Safety Switch (SW1)

4. ELECTRICAL COMPONENT DESCRIPTIONS

Index No.	Name	Function	Symbol
Motors			
2	Wheel Drive Motor	Drives the wheel that changes the bin positions	M1
3	Roller Drive Motor	Drives all rollers in the sorter paper path	M2
Sensors			
1	Paper Sensor	Misfeed detection for the sorter	S1
4	Bin Home Position Sensor	Detects when all bins are in the down position (home)	S2
5	Wheel Sensor	Detects each half-turn of the wheel (1 bin is changed for each half-turn)	S3
Switch			
7	Cover Safety Switch	Detects when the sorter cover is opened	SW1
Printed Circuit Board			
6	Sorter Main Board	Controls all sorter functions. Communicates with the copier main board through the interface PCB	PCB1

5. BASIC OPERATION

- Clear Mode -

When the main switch of the copier is turned on, the sorter automatically assumes a clear mode condition. It also changes to clear mode if sort or stack mode is recalled or if the interrupt key is pressed. In clear mode, all copies are stacked on the proof tray.

Sorter operation starts when the copier sends the paper feed signal to the selected paper feed station. At this time the roller drive motor energizes. The roller drive motor de-energizes when the paper exits the copier and the paper sensor is actuated (lifted up). The paper sensor signal is sent to the copier through an interface board to check for a paper misfeed. The wheel drive motor does not turn on when in clear mode.

- Sort Mode -

After sort mode is selected by pressing the Sorter key, the wheel drive motor turns on to move the proof tray up. The start timing of the roller drive motor is the same as in clear mode. At 250 ms after the paper sensor turns off, the paper is safely in the bin, so the wheel drive motor turns and advances the bins one step. When the wheel sensor is de-activated, the next bin is in position, so the wheel drive motor turns off.

- Stack Mode -

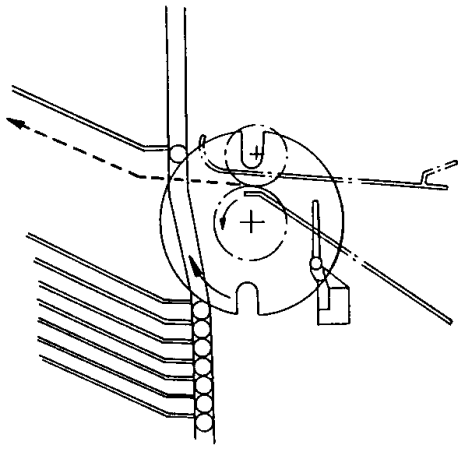
As in clear mode, the roller drive motor turns on when the copier sends the paper feed signal to the selected paper feed station. All copies of the copy run are then fed to the first bin. At 250 ms after the final copy passes the paper sensor, the wheel drive motor turns on and advances the bins one step.

There are no limits on the number of copies that can be entered up to the full 999 copy limit of the copier. However, the physical capacity of the bins is a good deal less. (See "Bin Capacity" in the specifications.)

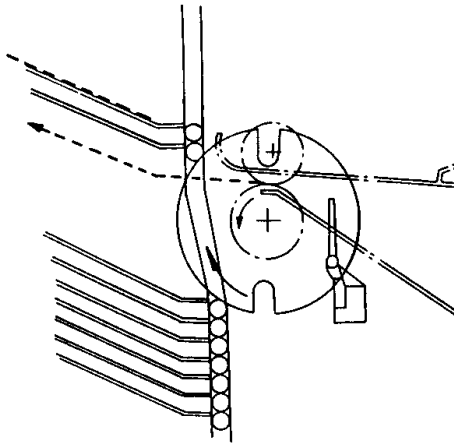
When all 20 bins have been used, the wheel drive motor turns on until all the bins have been lowered (including the proof tray).

6. EXAMPLE OF SORT MODE OPERATION

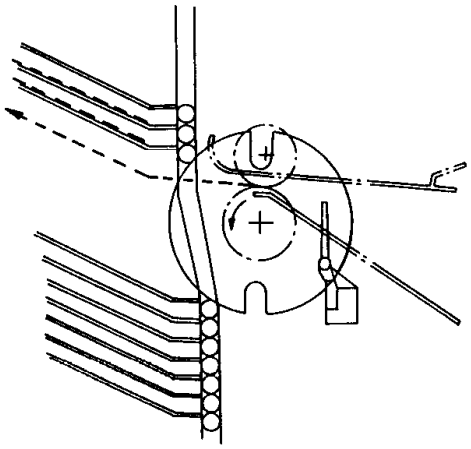
1)



2)



3)



The following explains how the sorter handles three consecutive three-copy runs of a single original in sort mode. This illustrates what happens when an odd number of copies of a multi-page original is made.

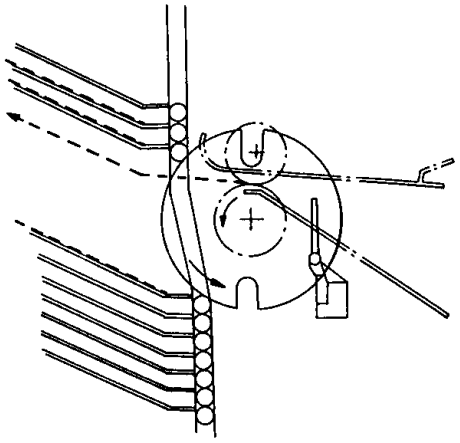
- Start Key Pressed for the First Copy Run -

1) The first copy feeds to the first bin. When the copy is in the bin, the wheel sensor turns off. After that, the wheel drive motor turns on and moves the first bin up.

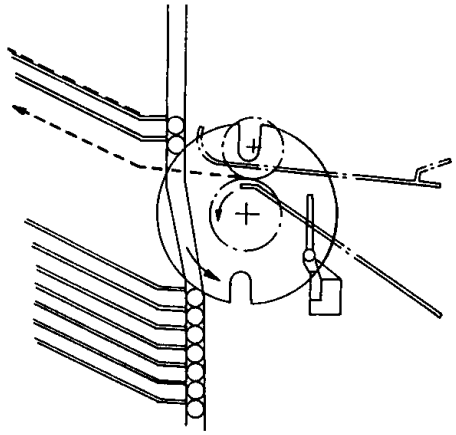
2) The same action as #1.

3) The third copy feeds to the third bin. As this is the final copy, the wheel drive motor does not turn on this time after the paper sensor turns off. (The sorter will stay at this position until auto-reset or until copying resumes.)

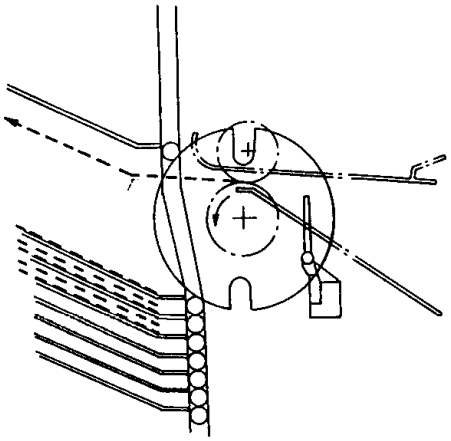
4)



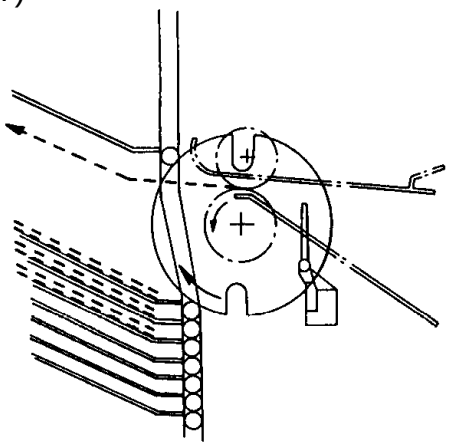
5)



6)



7)



- Start Key Pressed for the Second Copy Run -

4) The first copy is fed to the third bin. After the paper sensor turns off, the wheel drive motor turns on and moves the second bin down.

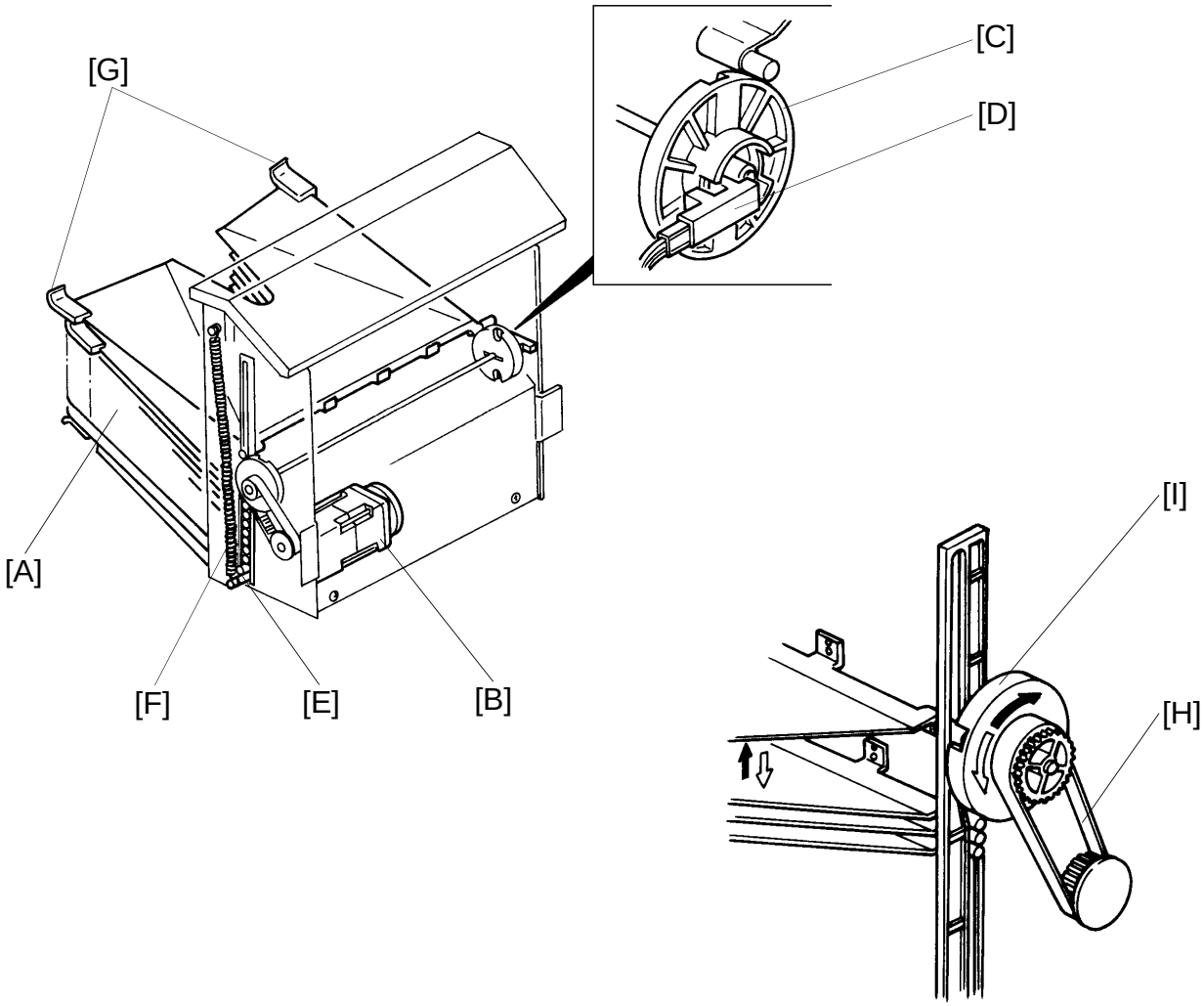
5) The same as #4.

6) The third copy is fed to the first bin. The wheel drive motor does not turn on after the paper sensor turns off.

- Start Key Pressed for the Third Copy Run -

7) The first sequence (1, 2, and 3) is repeated.

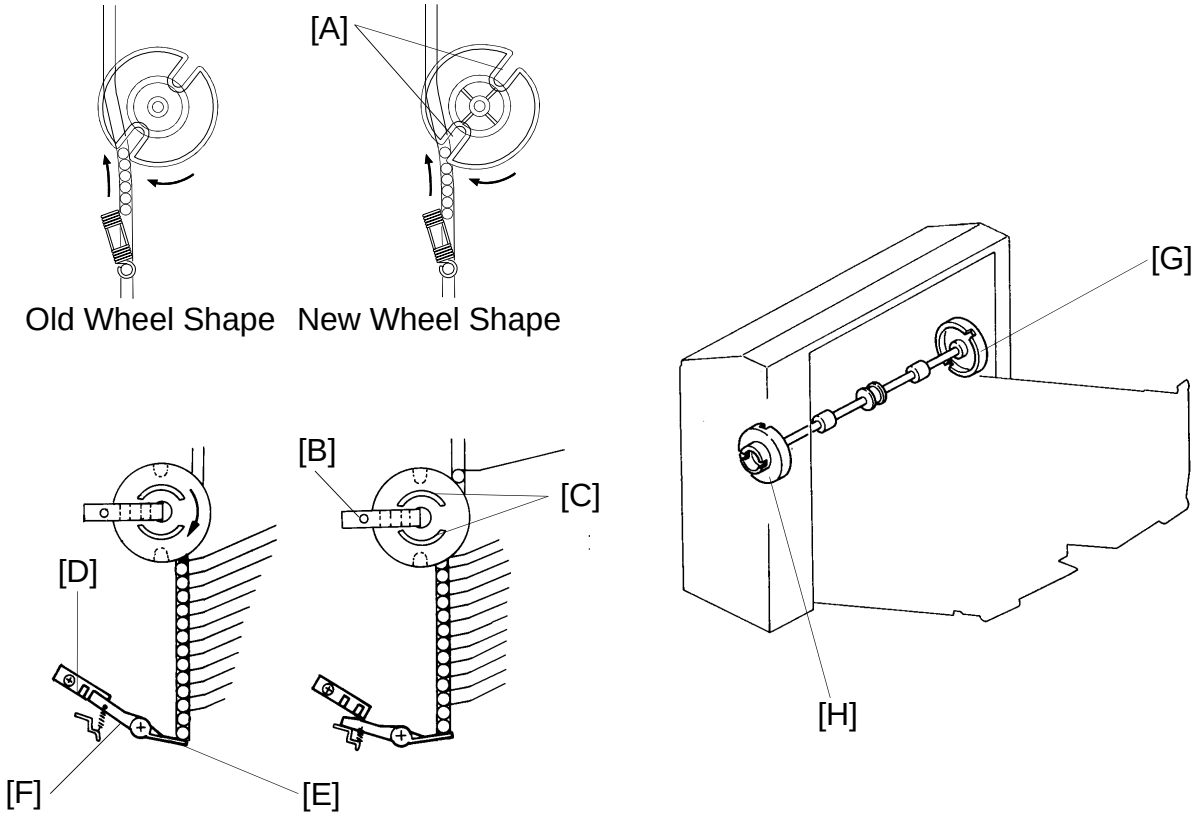
7. BIN DRIVE MECHANISM



The bin drive mechanism moves the bins [A] up and down to receive copies under the direction of the copier CPU. The main components in this mechanism are the wheel drive motor [B], the two transfer wheels [C], the wheel sensor [D], and the bins themselves.

Pins on either side of each bin slide up and down in slots in the sorter side frame. The bins rest on each other with the bottom one resting on the lift bar [E]. The springs [F] on either end of the lift bar lift it up, forcing the bin pins against the transfer wheels. Plastic spacers [G] on both ends of each bin keep the bins separated.

To move the bins up, the wheel drive motor turns clockwise (as viewed from the front). A timing belt [H] turns the transfer wheels [I].



The transfer wheels have two slots [A] in them 180 degrees apart. As the transfer wheels turn, these slots engage the pins of the bins and lift them up. Each time the transfer wheels turn 180 degrees, they raise one bin.

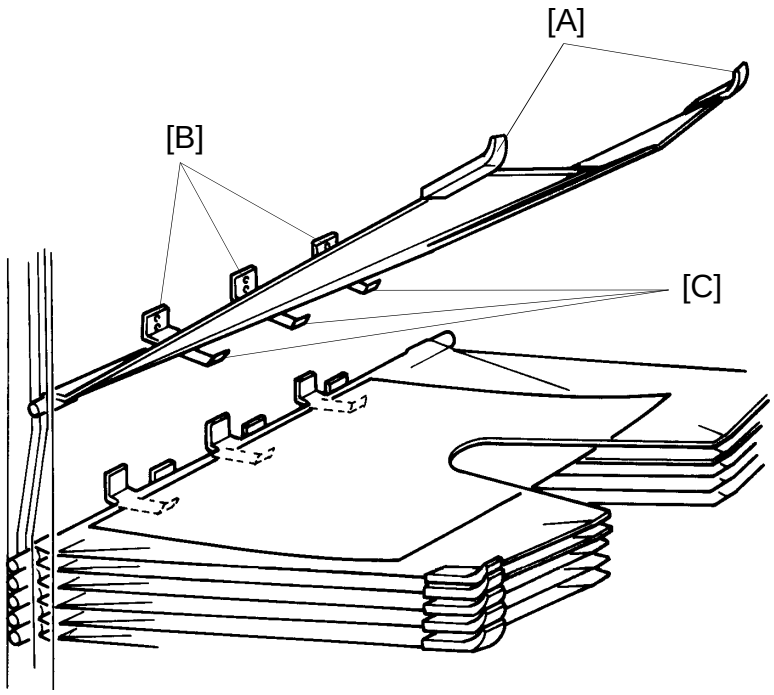
The CPU counts the bins using the wheel sensor [B]. This sensor monitors the movement of the wheel drive motor as well. When one of the slots on the cylindrical actuator [C] passes the sensor, the sensor is deactivated and the wheel drive motor turns off.

To move the bins down, the CPU reverses the wheel drive motor and the above process reverses.

The bin home position sensor [D] is located at the lower rear end of the sorter. When all the bins are lowered, the lift bar [E] presses down on the actuator [F], actuating the sensor. The CPU checks the sensor whenever the power is turned on. At this time, if the bins are not in the home position, the home position sensor is deactuated and the CPU will return the sorter bins to the home position.

The mounting position is about 18.5 degrees off between the front transfer wheel [G], and the rear transfer wheel [H]. Therefore, the front and rear of the bins do not rise simultaneously, thus preventing unusual noise and reducing load. Also, the shape of the transfer wheels has been modified from previous models to reduce banding on copies that is caused by vertical slippage due to the movement of the sorter bins.

8. BINS

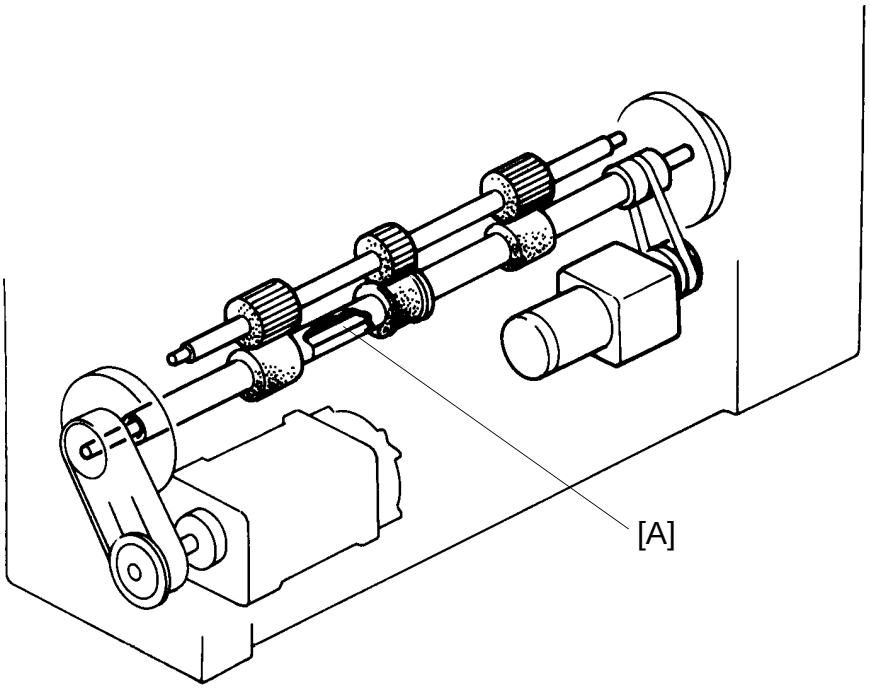


The proof tray and the twenty bins are all basically the same. Formed out of thin flexible steel plate, they have spacers [A] at the end to hold them apart and pins at the front and rear on the other end, which are inserted in guide slots in the sorter frame.

The stoppers [B] prevent copies from sliding back into the sorter after they have been fed out. The arrangement of these stoppers is different for even and odd numbered bins.

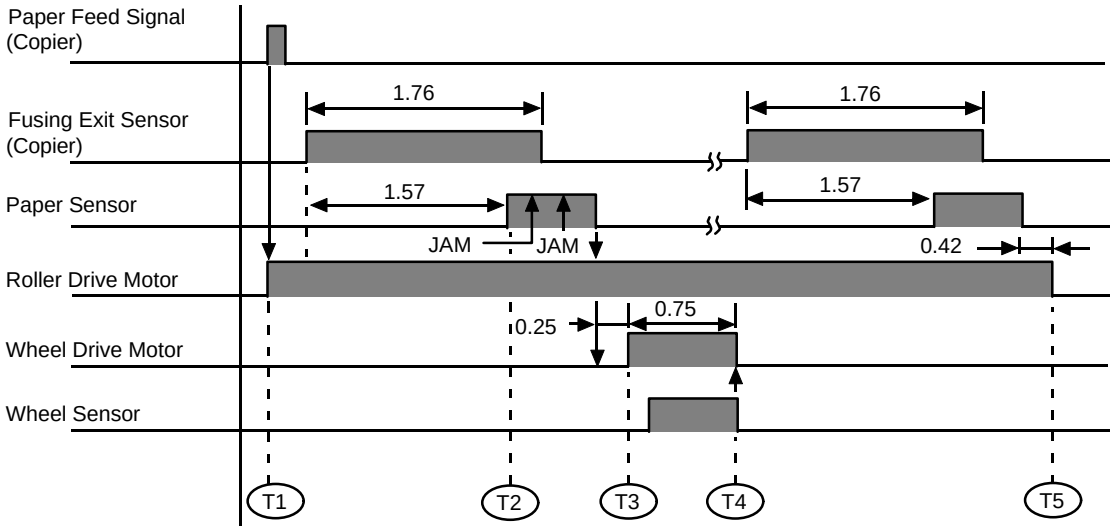
Three leaf springs [C] on the underside of each bin hold the copies flat in the underlying bin.

9. EXIT ROLLERS



The exit roller shaft is hollow and is mounted coaxially on the transfer wheel shaft [A]. When the copier sends a signal to the selected paper feed station to feed paper, the CPU sends a signal to the sorter to turn on the roller drive motor. After copying, the roller drive motor turns off at the same time as the copier main motor.

10. TIMING CHART



T1: When the copier sends the paper feed signal to the selected paper feed station, the roller drive motor starts rotating.

T2: 1.57 seconds after the fusing exit sensor turns on, the paper sensor turns on.

T3: 0.25 second after the paper sensor turns off, the wheel drive motor starts rotating and shifts the bin.

T4: When the wheel sensor is de-actuated, the wheel drive motor turns off.

T5: 0.42 second after the paper sensor turns off, the roller drive motor stops.

SORTER (A557)

1. SPECIFICATIONS

Number of Bins: 10 bins

Paper Size for Bins: Sort/Stack Mode
Maximum - A3, 11" x 17"
Minimum - A5, 5 1/2" x 8 1/2"

Paper Weight: Sort/Stack Mode: 64 to 90 g/m^2 (17 to 24 lb)
Non-Sort/Stack Mode: 52 to 162 g/m^2 (14 to 43 lb)

Bin Capacity:

	Sort/Stack Mode (All Bins)	**Non Sort/Stack Mode (Top Bin)**
A4, 8 1/2" x 11" or less	20	100
B4, 8 1/2" x 14"	15	100
A3, 11" x 17"	10	100

Power Source: +5 volts and +24 volts from the copier

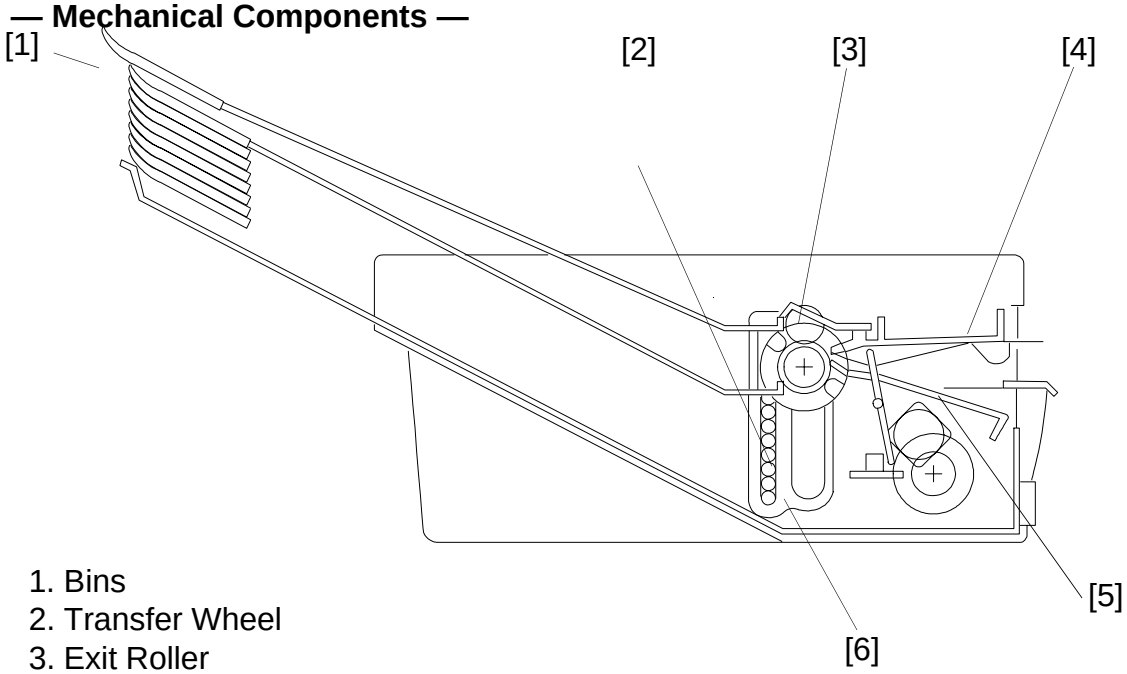
Power Consumption: 15 W

Dimensions: (W x D x H) 402 mm x 455 mm x 217 mm
(15.7" x 17.8" x 16.7")

Weight: 7.5 kg (16.5 lb)

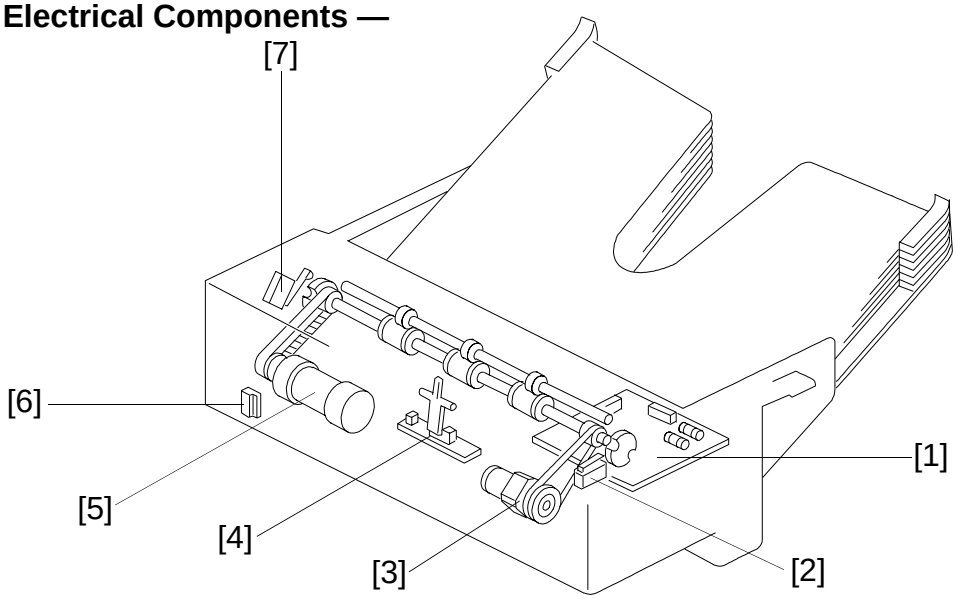
2. COMPONENT LAYOUT

— Mechanical Components —



1. Bins
2. Transfer Wheel
3. Exit Roller
4. Upper Paper Guide
5. Lower Paper Guide
6. Bin Guide

— Electrical Components —



1. Sorter Main Board
2. Wheel Switch
3. Roller Drive Motor
4. Paper Sensor
5. Bin Drive Motor
6. Sorter Switch
7. Bin Home Position Switch

3. ELECTRICAL COMPONENT DESCRIPTIONS

Symbol	Name	Function	Index No.
Motors			
M1	Roller Drive Motor	This dc motor drives the lower exit rollers.	3
M2	Bin Drive Motor	This reversible dc motor moves the bins up or down.	5
Switches			
SW1	Wheel Switch	Detects the rotation of the transfer wheel and stops it in the correct position.	2
SW2	Sorter Switch	This reed switch becomes activated when the sorter is in the proper position (aligned next to the copier). It also works as a jam reset switch for the sorter.	6
SW3	Bin Home Position Switch	Informs the CPU that all the bins are lowered.	7
Sensors			
S1	Paper Sensor	Serves as the misfeed sensor for the sorter and also sets exit roller and bin drive timing.	4
Printed Circuit Boards			
PCB1	Sorter Main Board	Serves as the communication board between the copier main board and the sorter.	1

4. BASIC OPERATION

- Clear Mode -

When the main switch of the copier is turned on, the sorter automatically assumes clear mode. In this mode, all copies are stacked in the first bin. The sorter also assumes clear mode when interrupt mode is selected.

Sorter operation begins when the copier sends the paper feed signal to the selected paper feed station. At this time, the roller drive motor energizes. When the paper exits onto the sorter bin, the paper sensor is de-activated and the roller drive motor is then de-energized. The copier main board monitors the paper sensor through the sorter main board to check for paper misfeeds.

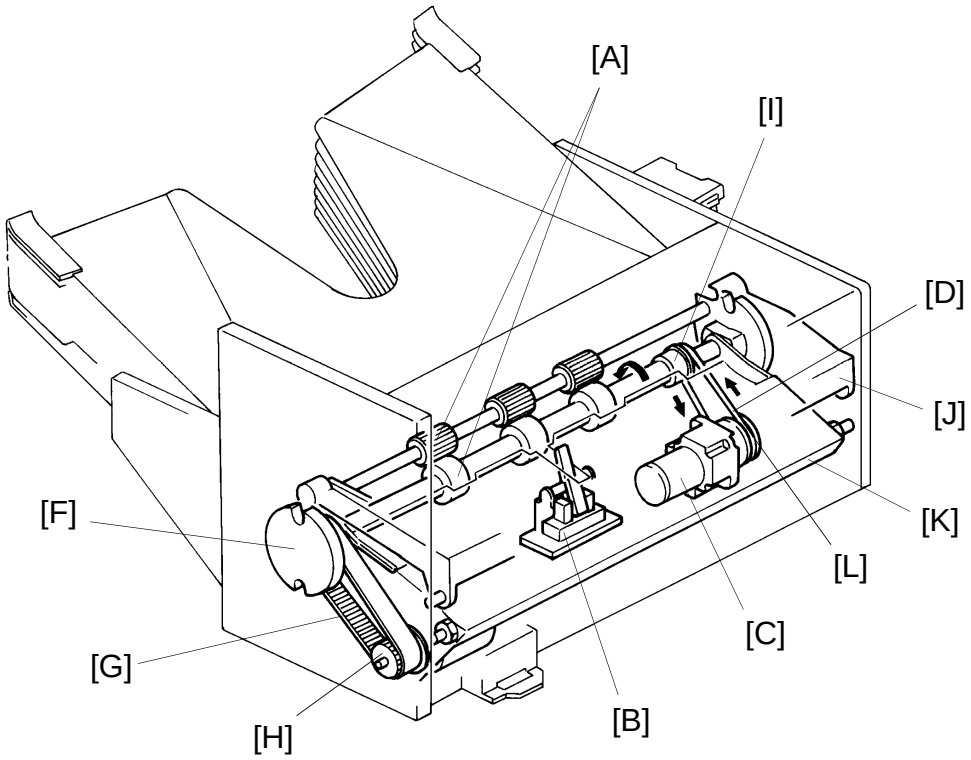
- Sort Mode -

In this mode, all copies of the first original are delivered to separate bins starting from the top. The copies of the second original are delivered to the same bins, but starting from the bottom. The copies of the third original start from the top and so on. At 250 milliseconds after the copy has gone through the paper sensor, the bin drive motor turns on to advance the bin one step.

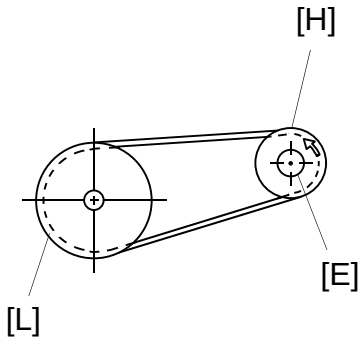
- Stack Mode -

In this mode, all copies of the first original are delivered to the first bin, all copies of the second original are delivered to the second bin, and so on. At 250 milliseconds after the last copy of the original has gone through the paper sensor, the bin drive motor turns on to advance the bin one step.

5. EXIT ROLLER DRIVE MECHANISM



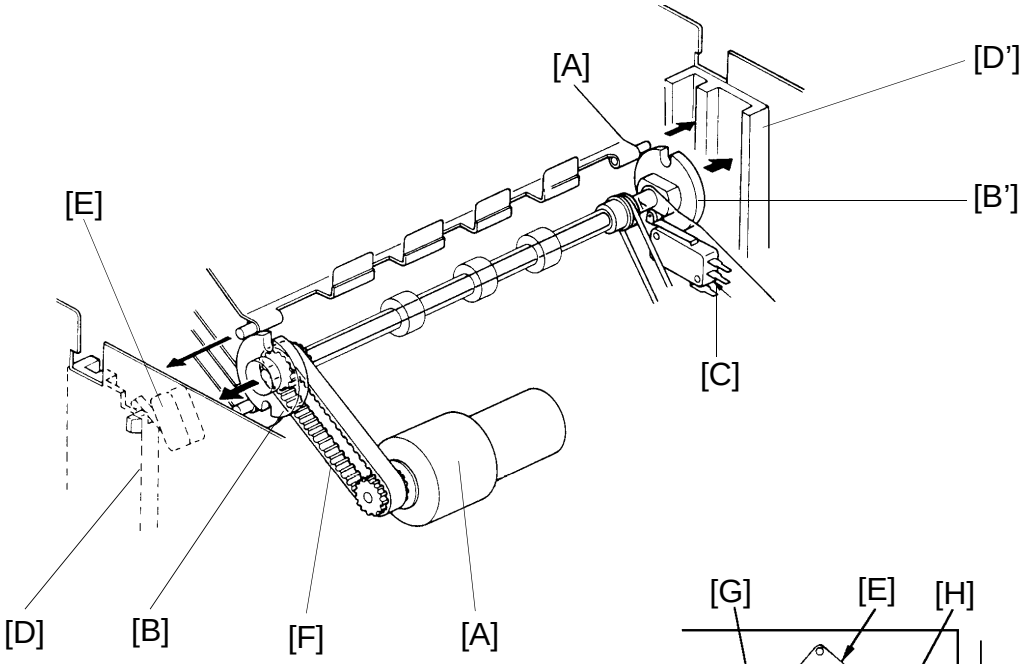
F: Transfer Wheel
G: Bin Drive Belt
H: Bin Drive Pulley
I: Exit Roller Pulley
J: Upper Paper Guide
K: Lower Paper Guide
L: Roller Drive Motor Pulley



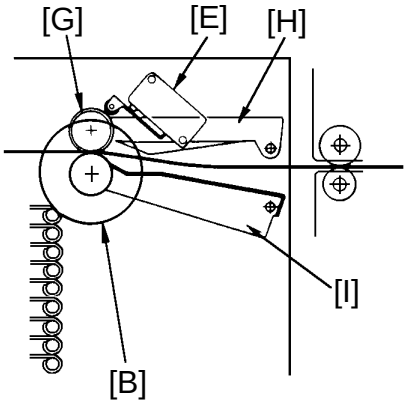
The exit rollers [A] take over paper transport from the copier. When the copier sends the paper feed signal to the selected paper feed station, the exit rollers start rotating. The exit rollers continue to rotate for 250 milliseconds after the copy paper has gone through the paper sensor [B].

The roller drive motor [C] rotates the lower exit roller via the roller drive belt [D]. The shaft of the lower exit roller is a cylindrical cavity type which rotates around the transfer wheel shaft [E]. The paper sensor is positioned just in front of the exit rollers. The paper sensor detects misfeeds in the sorter.

6. BIN DRIVE MECHANISM

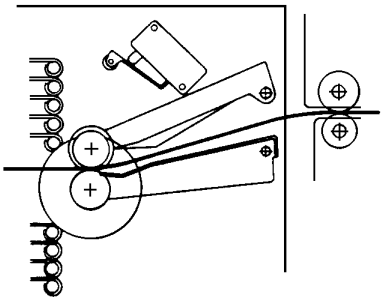


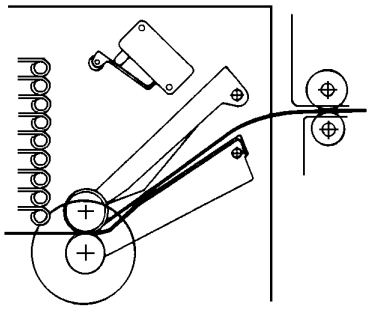
G : Exit Roller
H : Upper Paper Guide
I : Lower Paper Guide



The bin drive mechanism moves the bins up and down to receive copies under the direction of the copier CPU. The main components in this mechanism are the bin drive motor [A], two transfer wheels [B,B'], the wheel switch [C], and the bins themselves.

Pins on either side of each bin are inserted into slots called bin guides [D,D']. The bins slide up and down in the bin guides. The bins sit on each other with the lower bin resting on the 10th bin (the 10th bin is permanently fixed in position). The upper and lower paper guides pivot up and down depending on the height of the bin to be picked up or released.





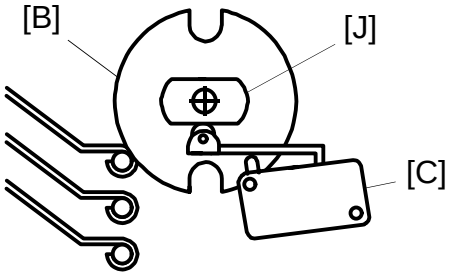
The bin home position switch [E] informs the CPU when all the bins are lowered.

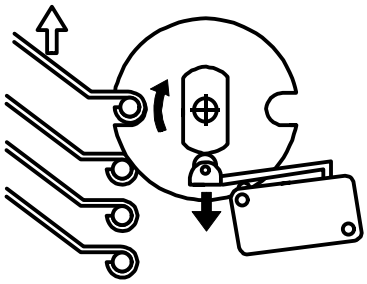
To move the bins up, the bin drive motor turns clockwise (as viewed from the front). A timing belt [F] turns the transfer wheels.

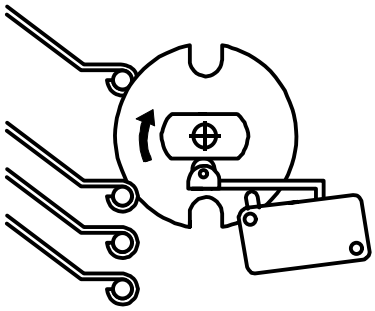
The transfer wheels have two slots in them 180 degrees apart. As the transfer wheels turn, these slots engage the bins and lift them up. Each time the transfer wheels turn 180 degrees, they raise one bin.

To move the bins down, the CPU reverses the bin drive motor and the above processes reverses.

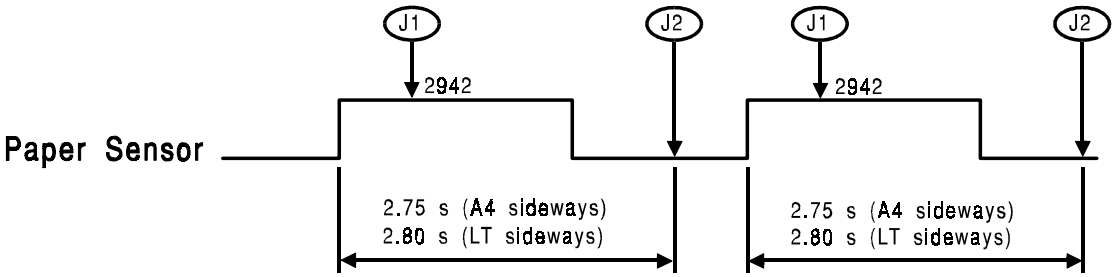
The CPU monitors the position of the bins through pulses generated by the wheel switch and the actuator cam [J]. The actuator cam has two flat sides that are 180 degrees apart and is mounted behind the rear transfer wheel. A pulse is generated each time one of the lobes of the actuator cam passes the wheel switch.







7. MISFEED DETECTION



In addition to being used for the exit roller drive timing, the paper sensor checks for misfeeds in the sorter.

J1 - Paper Sensor On Check: The copier CPU checks whether the paper sensor is actuated within 942 pulses (3.8 seconds) after the registration clutch turns on (at 2,000 pulses).

J2 - Paper Sensor Off Check: The copier CPU starts a timing cycle when the paper sensor is actuated. Then, at 2.75 (A4 sideways) or 2.80 (Letter sideways) seconds, the CPU checks whether the copy paper has passed through the paper sensor.

In misfeed condition, the "Check Paper Path" and "Misfeed Location" indicators light and copier operation is disabled. To recover the sorter from the misfeed condition, the sorter has to be slid away from the copier, the misfed paper removed, and the sorter returned to its original position.